



## Workshop Manual Suran, Sportvan 2006 ➤

4-Cylinder diesel engine (Engine 1.9 l)

Engine ID

ASY

Edition 05.2011



## List of Workshop Manual Repair Groups

### Repair Group

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Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.



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## 00 – Technical data

### 1 Technical data

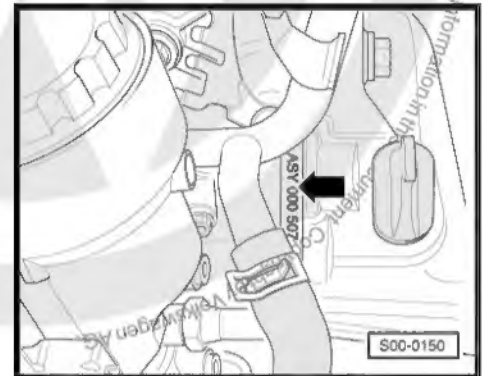
#### 1.1 Engine number

The engine number consists of up to nine characters (alphanumeric). The first part (no more than 3 identification letters) represents the "the engine identification letters", the second part (6 characters) is the "serial number". If more than 999,999 engines with the same ??identification characters are produced, the first of the six characters is replaced by a letter.

The engine number ("identification letters" and "serial number") are on the engine block, in the engine/transmission separation area.

Additionally, on the mechanical distribution cover there is a sticker -arrow- showing "the engine identification letters" and "serial number".

Engine identification characters are also indicated on the vehicle data plate.



#### 1.2 Engine characteristics

Identification letters		ASY
Production		11.01 ▶
Capacity	l	1.9
Power	kW/rpm	47/4000
Torque setting	Nm/rpm	125/1600...2800
Bore	Ø mm	79,5
Stroke	mm	95,5
Compression ratio		19,5
RON	minimum	49
Firing order		1-3-4-2
Catalyzer unit		yes
Recirculation of exhaust gases		yes
Overfed		not
Intercooler		not

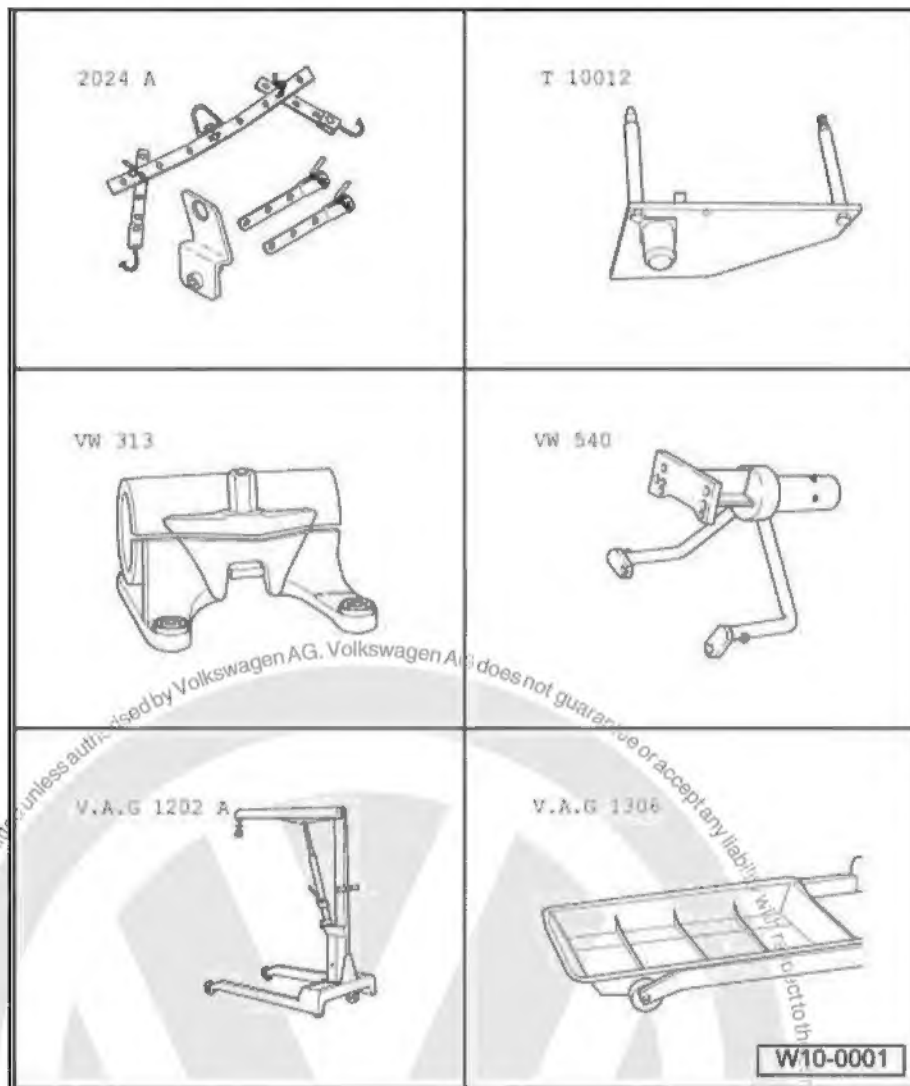


## 10 – Cylinders, engine block, support, cover

### 1 Engine - remove and install

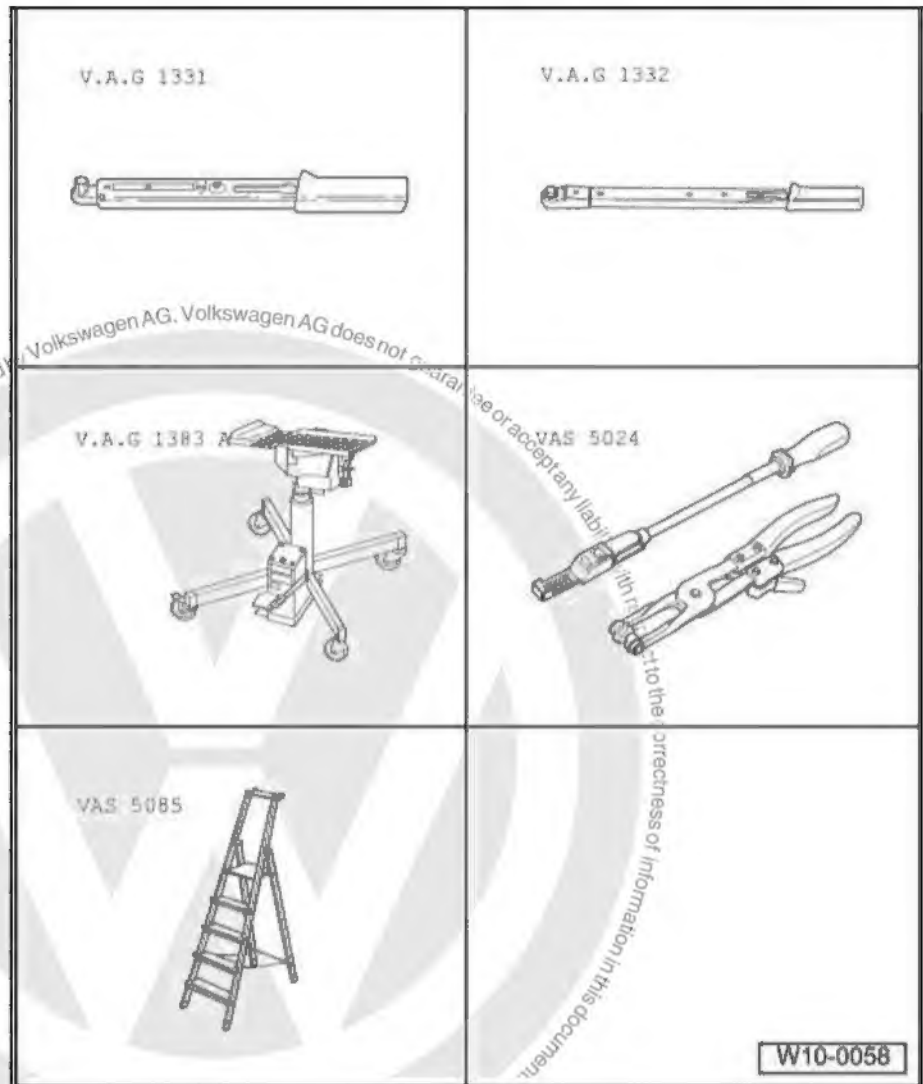
Special tools and workshop equipment required

- ◆ Support bracket -2024A-
- ◆ Support -T 10012-
- ◆ Support -VW 313-
- ◆ Support -VW 540-
- ◆ Hydraulic hoist -V.A.G 1202 A-
- ◆ Drip tray -VAG 1306-

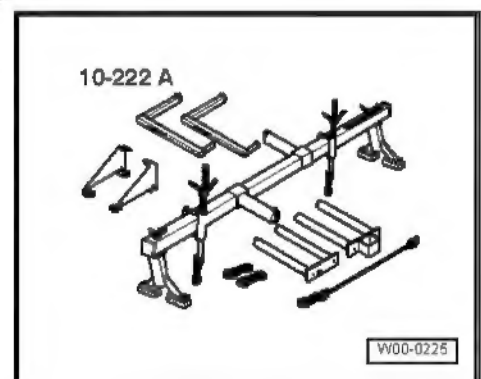




- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Torquemeter - 40 to 200Nm (socket 1/2") -VAG 1332-
- ◆ ?Engine-/gearbox jack - VAG 1383A-
- ◆ Standard type clamp pliers -VAS 5024A-
- ◆ 5 step ladder -VAS 5085-



- ◆ Bracket or VW 061 -10-222A- with Bracket -10-222A/1-



- ◆ Adapter -10-222A/18-
- ◆ Support -3147-
- ◆ Screw M10×25 / 8.8
- ◆ Cable clamps
- ◆ Grease (vehicles with manual transmission) -G 000 100-



## 1.1 Removal - instructions



### Note

*Check whether the vehicle has a coded radio. If so, request the anti-theft code before disconnecting the battery earth strap.*

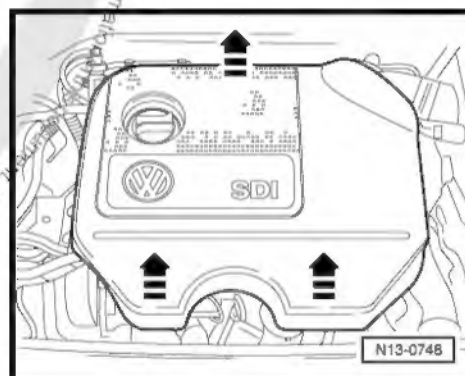
- The engine is removed along with the gearbox from the front.
- With the ignition switched off, disconnect the battery ground cable of Battery -A-.



### WARNING

*For installation work, especially in the engine compartment, due to reduced existing space, consider the following:*

- ◆ *All hoses (e.g. fuel, hydraulic, activated charcoal filter system, coolant and refrigerant gas, brake fluid, vacuum) and electric cables must be arranged in a way to return to their original positions.*
  - ◆ *Ensure easy access to all mobile parts or that may be hot.*
- All cable clamps that open or break during the engine removal shall be replaced and installed on the same place when installing the engine.
  - Remove the engine cover in the direction of the arrows.
  - Remove the Battery -A- ⇒ Electrical system; Rep. Gr. 27 ; Starter, generator, battery .





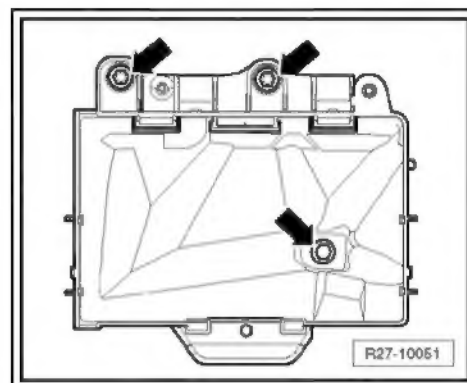
- Remove Battery -A- -arrows- ⇒ Electrical system; Rep. Gr. 27 ; Starter, generator, battery .

The cooling system is under pressure when the engine is hot. For this reason it is necessary to reduce pressure prior to any repairs.



#### WARNING

*Hot steam may escape while opening the coolant container, thus put a cloth over the cover to open it carefully.*



- Respect cleaning rules ⇒ [page 81](#) .
- Remove the connection hose between air cleaner and intake air tube.
- Remove air filter.
- Remove lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50 ; Noise insulation - remove and install .
- Loosen right and left articulated shafts and fasten them on top:⇒ Running gear, axles, steering; Rep. Gr. 40 ; Semi-articulated shafts - remove and install .
- Release the exhaust pipe's manifold exhaust tube ⇒ [page 102](#) .
- Drain cooling fluid ⇒ [page 68](#) .
- Remove the hoses from the engine's cooling system with Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A- .
- Remove/disconnect all necessary engine and gearbox electrical connections.
- Remove all vacuum and intake hoses of the cooling system from the engine.
- Loosen actuator cylinder of hydraulic gear ⇒ 5-speed stick manual gearbox 02T; Rep. Gr. 30 ; Repair the clutch activation
- Remove the gear selection mechanism ⇒ 5-speed stick manual gearbox 02T; Rep. Gr. 34 ; Gear selection mechanism - remove and install .

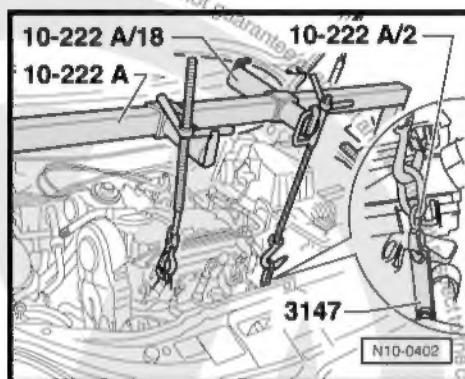
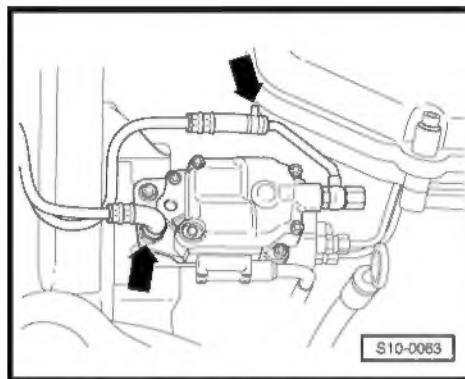


#### WARNING

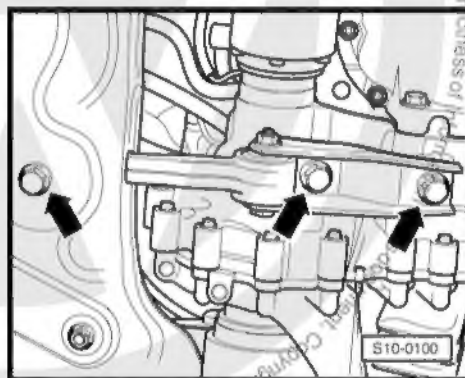
- ◆ *Fuel as well as fuel piping may get very hot (danger of burns).*
- ◆ *Besides that, the fuel system is also under pressure! Prior to loosening the hose junctions, place a cloth around them. Then eliminate the pressure by carefully removing the hose.*
- ◆ *For all installation work on the fuel system, wear safety goggles and protection gloves!*



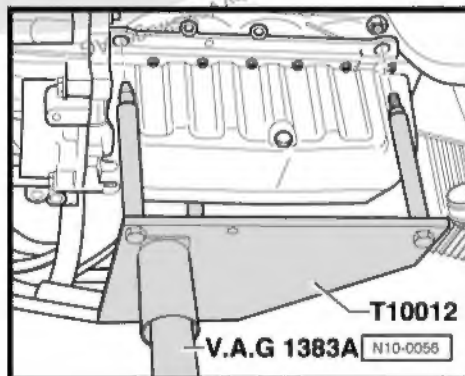
- Disconnect fuel supply and return hoses -arrows- at the injection pump.
- Seal the tubes to prevent dirt from entering the fuel supply system.
- Respect cleaning rules ⇒ [page 81](#) .
- Remove Poly-V belt ⇒ [page 14](#) .
- Release the air conditioning compressor ⇒ Rep. Gr. 87 .
- Observe the additional notes and installation jobs ⇒ [page 10](#) .
- Removing alternator ⇒ Electrical equipment; Rep. Gr. 27 ; Alternator with Poly-V strap - remove and install .
- Install the Bracket or VW 061 -10-222A- with Bracket -10-222A/1- and support the engine and the transmission.



- Install pendulum support -arrows-.
- Install the Support -T 10012- on the Engine-/gearbox jack - VAG 1383A- .



- With the fastening nut and the screw M10x25 / 8.8, fasten the Support -T 10012- to the engine block with 40 Nm of torque.
- Slightly lift the engine with the transmission, using the Engine-/gearbox jack -VAG 1383A- .



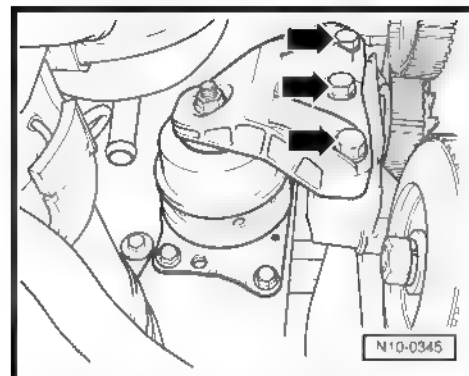


- Loosen, from above, the aggregate support -arrows- at the engine support side



**Note**

To remove the fastening screws, use the 5 step ladder -VAS 5085-

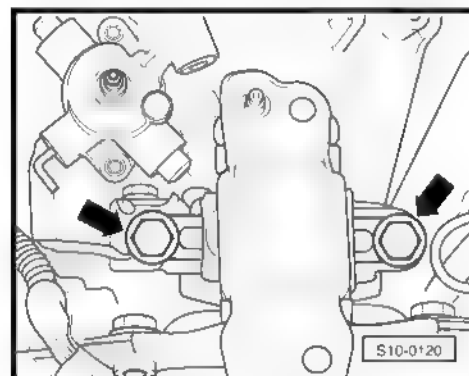


- Loosen, from above, the aggregate support -arrows- on the transmission support side.
- Remove the spindles of the Bracket or VW 061 -10-222A- of the engine.
- Carefully lower the engine with the gearbox.



**Note**

When lowering, lead the engine carefully to prevent damages to the body.



## 1.2 Engine - fix on the assembly support

To carry out assembly work, the engine must be fixed to the engine/transmission stand Spanner for loosening and tightening the pinion nut -3132- on the Support -VW 540-.

To do installation jobs, Support -VW 540- must be secured to Support -VW 313- on the installation support.

### Work sequence

- Remove the gearbox.
- Remove the gearbox flange.
- Remove the thrust pad.
- Remove the inertial flywheel.
- Remove the intermediate plate.

## 1.3 Notes on installation

Installation is carried out in the reverse order of removal, considering the following:



**WARNING**

For installation work, especially in the engine compartment, due to reduced existing space, consider the following.

- ◆ All hoses (e.g. fuel, hydraulic, activated charcoal filter system, coolant and refrigerant gas, brake fluid, vacuum) and electric cables must be arranged in a way to return to their original positions.
- ◆ Ensure easy access to all mobile parts or that may be hot.

- Check the clutch bearing for wear and replace it, if necessary.



- Slightly lubricate the clutch bearing and the guide sleeve of the input shaft bearing with Lubricating grease -G 000 100- .
- If necessary, check the clutch disc centralization.
- Check if the gearbox and engine coupling guides are installed on the engine block and install them, if necessary.
- While engine installation, watch that the passage of the articulated shafts is free.
- Align the engine and slightly move it so that the supports are tension-free



#### Note

*Tightening torque for engine brackets ⇒ [page 9](#) .*

- Install the gear selection mechanism ⇒ 5-speed stick manual gearbox 02T; Rep. Gr. 34 ; Gear selection mechanism - remove and install .
- Loosen actuator cylinder of hydraulic gear ⇒ 5-speed stick manual gearbox 02T; Rep. Gr. 30 ; Repair the clutch activation .
- Remove the cooling and vacuum hoses.
- Install the air conditioning compressor.
- Install Poly V belt ⇒ [page 14](#) .
- Install alternator ⇒ Electrical equipment; Rep. Gr. 27 ; Alternator with Poly-V strap - remove and install .
- Power connections and their positions ⇒ Rep. Gr. 97 .
- Install the exhaust pipe in exhaust manifold ⇒ [page 102](#) .
- Fill cooling fluid ⇒ [page 68](#) .
- Perform a test drive and check the fault memory ⇒ [page 99](#) .

## 1.4 Tightening torque



### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

Location		Tightening torque
Screws and nuts	M 6	10 Nm
	M 7	15 Nm
	M 8	25 Nm
	M 10	40 Nm
	M 12	60 Nm
Different tightening torques		
Screws to connect the engine to the gearbox	M 10	45 Nm
Screws to connect the engine to the gearbox	M 12	80 Nm
Articulated shafts and flanges		40 Nm



Location	Tightening torque
Exhaust pipe to manifold	40 Nm



Note

*Tightening torques of accessory supports → page 9.*

## 1.5 Subframe

### 1.5.1 Tightening torque



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



Note

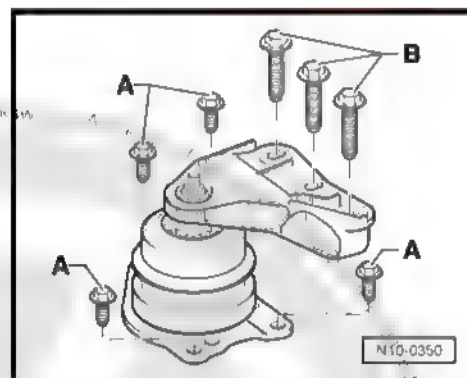
*The fixing screws of the subframe are expanding screws and shall be obligatory replaced.*

#### Engine subframe support

A -  $1/20$  Nm + 90°

B -  $1/30$  Nm + 90°

1) Replace

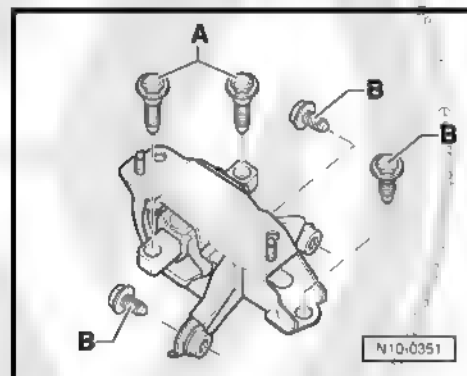


#### ?Gearbox subframe support

A -  $2/40$  Nm + 90°

B -  $2/50$  Nm + 90°

2) Replace



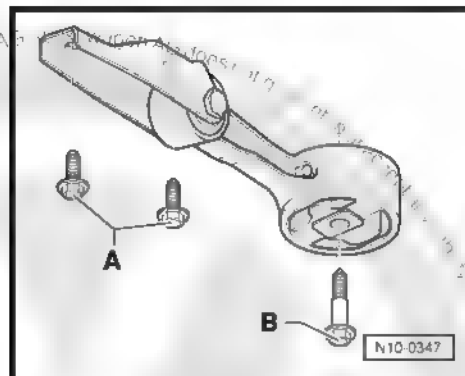


### Pendulum support

A -  $30 \text{ Nm} + 90^\circ$

B -  $40 \text{ Nm} + 90^\circ$

3) Replace



## 1.6 Additional indications related to installation



### WARNING

*Do not open the air conditioning refrigerant gas circuit.*



### Note

- ◆ *The refrigerant gas circuit shall only be opened by workshops with qualified personnel available and the necessary tools and equipment.*
- ◆ *In order to prevent damages to the condenser and refrigerant gas hoses, do not fold, twist or excessively stretch the hoses.*
- ◆ *When installing refrigerant gas hoses, avoid installing them in a way they could be damaged or touch mobile parts.*

In order to remove and install the engine without opening the refrigerant gas circuit:

- Remove the refrigerant gas hose clamp(s).
- Remove Poly-V belt ⇒ [page 14](#).
- Remove front panel and its components ⇒ Body Repairs; Rep. Gr. 50 ; Front panel - remove and install .
- Move radiator and condenser panel to the side to avoid stretching the refrigeration gas hoses.
- Release the air conditioning compressor ⇒ Heating, air conditioning; Rep. Gr. 87 ; Compressor - remove and install .



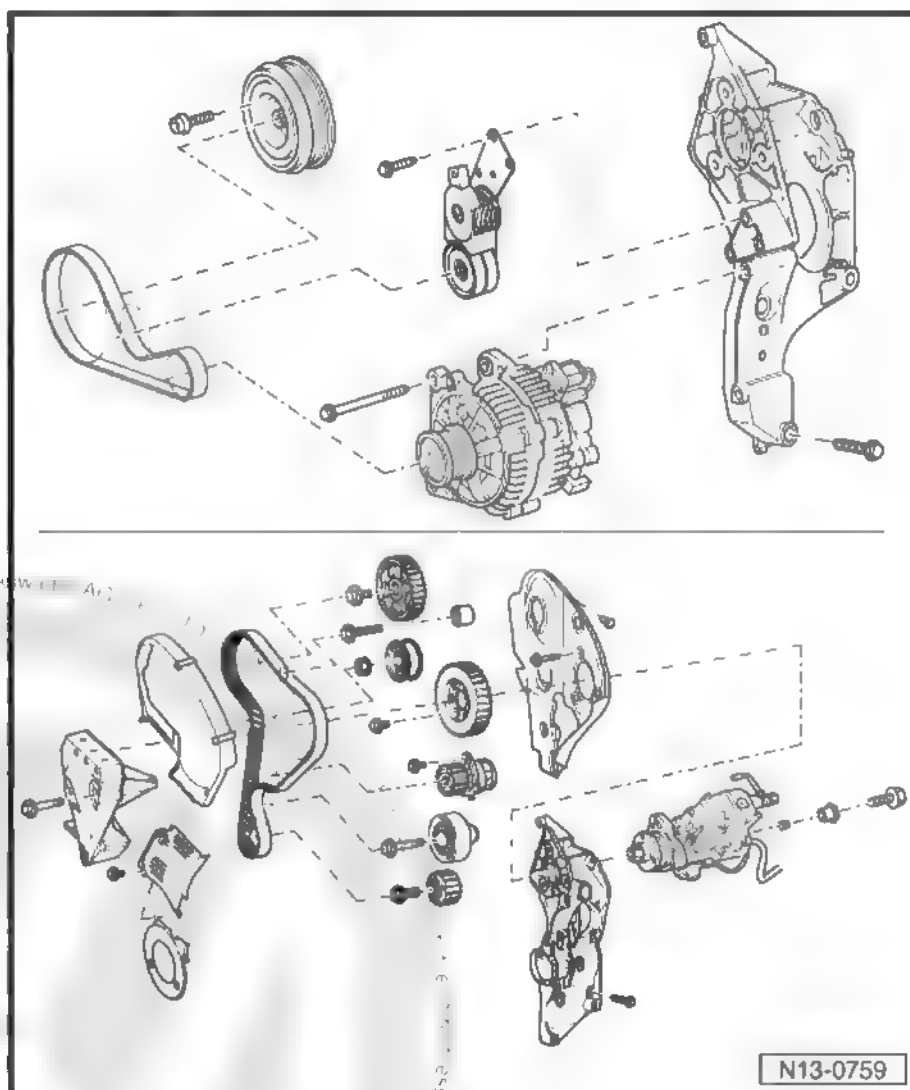
## 13 – Crankshaft, pistons

### 1 Engine - disassemble and assemble



#### Note

*In order to perform assembly work, attach the engine to the assembly support using Support -VW 540-.*



#### Note

- ◆ *In case metal shavings and large amounts of small metal particles are detected in the engine oil while repairing an engine mainly caused by friction of the crankshaft and rod bearings - replace the oil filter and carefully clean the oil galleries.*
- ◆ *All housing and bearing surfaces shall be lubricated with oil before assembly work*



I → [page 12](#)

II → [page 12](#)

#### Part I



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

1 - 10 Nm + 90°

2 - Pulley/vibration shock absorber

- ❑ There is only one installation position

3 - 25 Nm

4 - Poly-V belt tensioner

5 - Compact support

- ❑ While installing, watch that the coupling guides are centralized

6 - 45 Nm

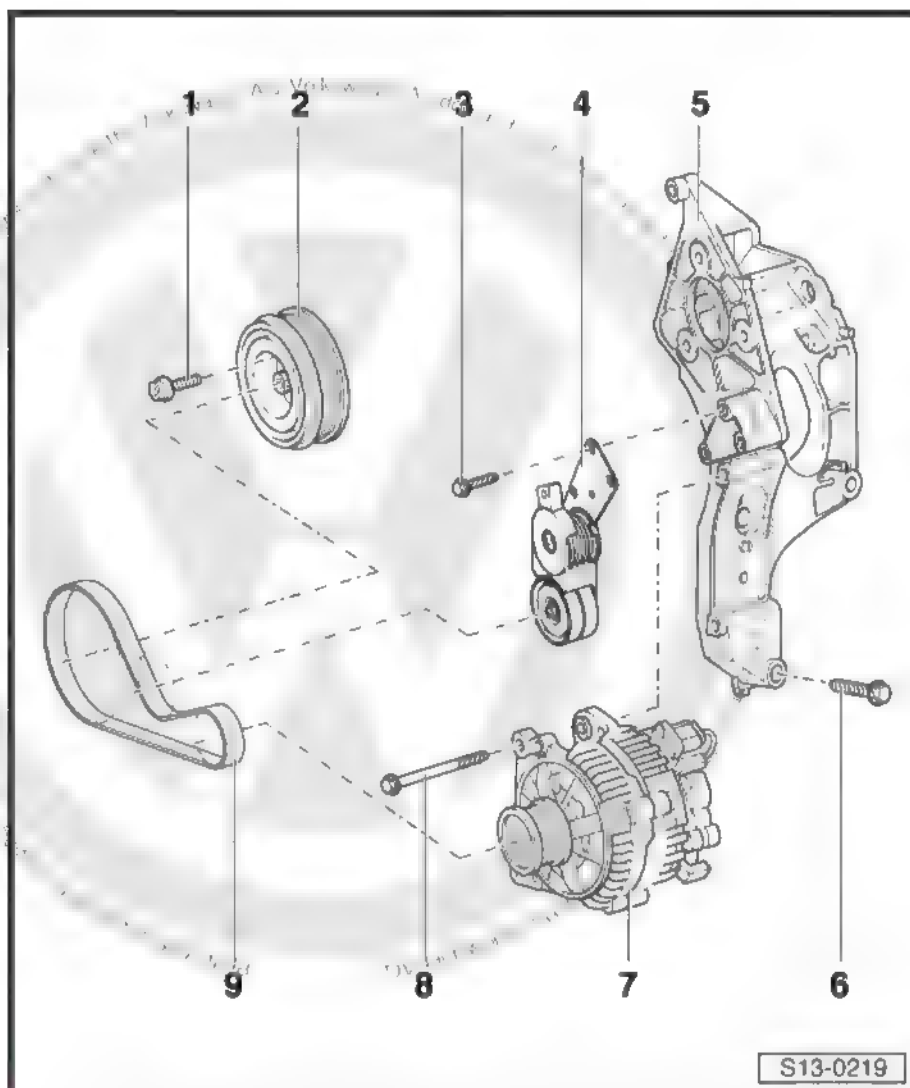
7 - Alternator

- ❑ Remove and install ⇒ Electrical equipment; Rep. Gr. 27 : Alternator with Poly-V strap - remove and install

8 - 25 Nm

9 - Poly-V belt

- ❑ Mark the direction of movement prior to removal
- ❑ Check for wear
- ❑ Do not fold
- ❑ Remove and install ⇒ [page 14](#)



#### Part II



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



- 1 - 45 Nm  
2 - Engine support  
3 - Upper part of the mechanical distribution cover  
4 - Toothed belt
- ☐ Mark the direction of movement prior to removal
  - ☐ Check for wear
  - ☐ Do not fold
  - ☐ Remove, install and adjust [⇒ page 33](#)

- 5 - 25 Nm  
6 - 25 Nm  
7 - 20 Nm  
8 - 45 Nm  
9 - Camshaft gear  
10 - Tensioner pulley
- ☐ Installation position [⇒ page 14](#)
  - ☐ Checking semiautomatic toothed belt tensioning roller [⇒ page 15](#)

- 11 - ?Deviation pulley  
12 - Injection pump gear  
13 - 10 Nm  
14 - 30 Nm  
15 - 15 Nm

- 16 - Mechanical distribution rear protector  
17 - Water pump
- ☐ Remove and install [⇒ page 72](#)

- 18 - ?Deviation pulley  
19 - Crankshaft gear

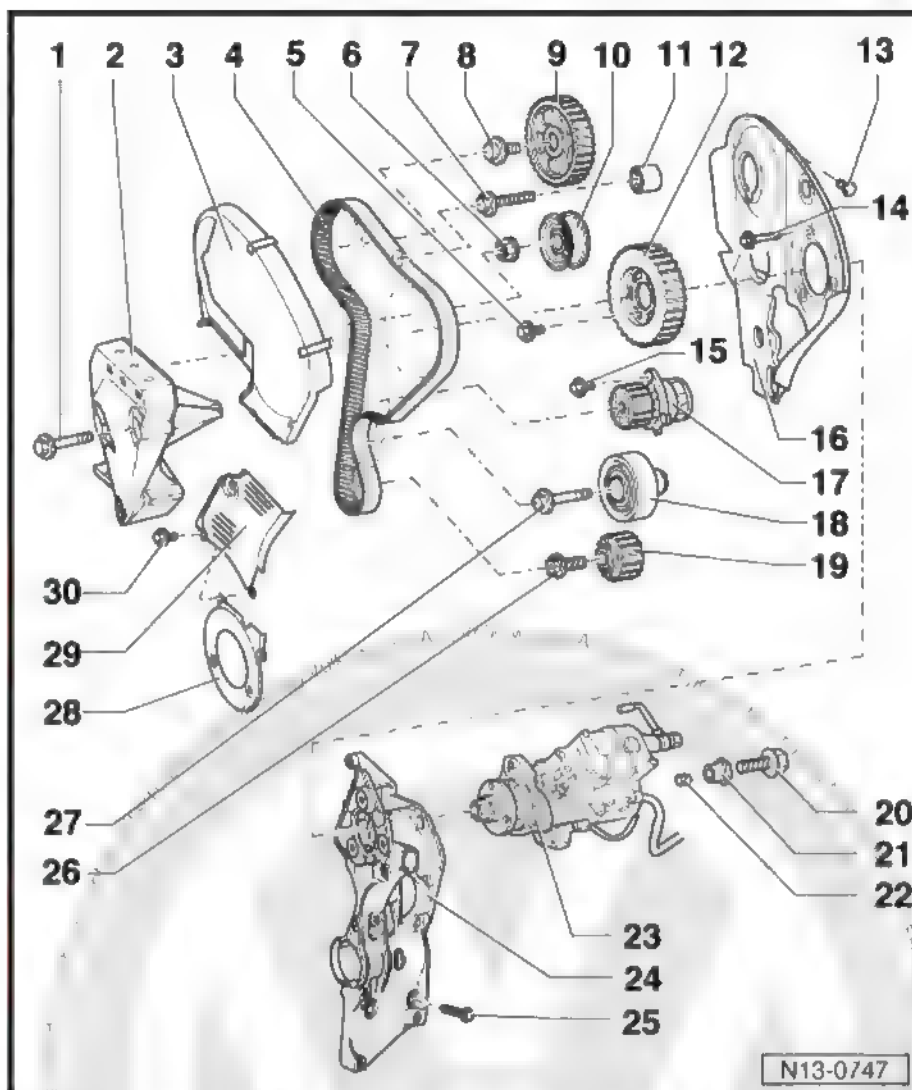
- 20 - 30 Nm  
21 - Sleeve  
22 - Fastening nut

- 23 - Injection pump
- ☐ Remove and install [⇒ page 92](#)

- 24 - Compact support
- ☐ While installing, watch that the coupling guides are centralized

- 25 - 45 Nm

- 26 - 120 Nm + 90°
- ☐ Replace
  - ☐ To loosen and tighten, use Wrench -3415-
  - ☐ Do not additionally lubricate or grease the thread and flange
  - ☐ Additional torque may be applied in various steps





27 - 40 Nm + 90°

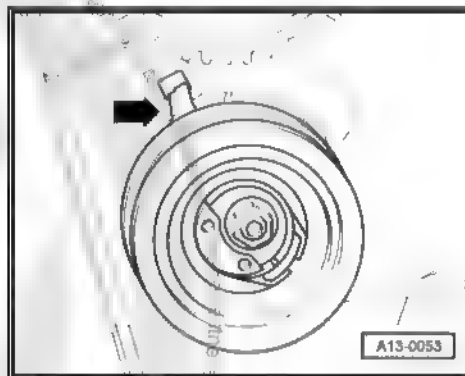
28 - Upper part of the mechanical distribution cover

29 - Protector

30 - 10 Nm

Installation position of the semiautomatic tensioner pulley

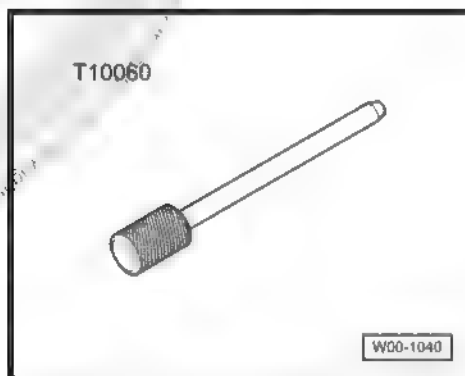
- The fastening device -arrow- for the tensioner pulley must fit into the mechanical distribution rear protection gap.



## 1.1 Poly-V belt - remove and install

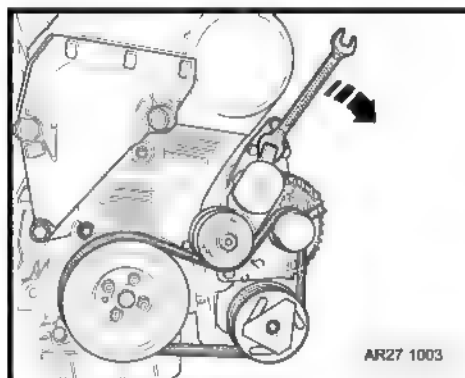
Special tools and workshop equipment required

- ◆ Pin -T 10060-



### 1.1.1 Removal

- Remove lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50 ; Noise insulation - remove and install .
- Mark the turning direction of the Poly V belt.
- Turn the tensioning element towards the -arrow- to loosen the Poly-V belt.
- Lock the tensor with Pin -T 10060- .
- Remove the Poly-V belt.



### 1.1.2 Installation

Installation is carried out in the reverse order of removal.



#### Note

- ◆ Prior to installing the Poly-V belt, watch that all accessories (generator, air conditioning compressor) are properly installed.
- ◆ During installation of the Poly V belt, observe the movement direction and proper seat of belt on the pulleys.

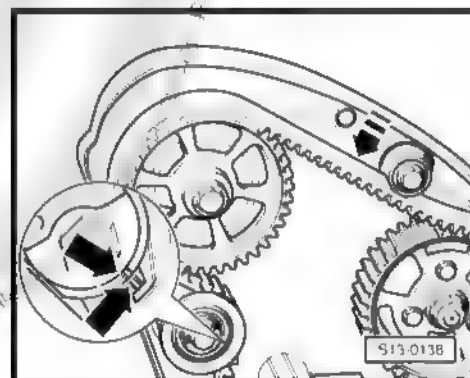
After finishing work:

- Start the engine and check the movement of the belt

## 1.2 Semi-automatic tensioner pulley of the toothed belt - check

Checking conditions:

- Installed and adjusted toothed belt.
- Strongly press the belt with your thumb. The notch and the elevation-arrows- must move
- Loosen the toothed belt. The tensioner pulley shall return to its original position.
- Should the groove and the elevation not fit, loosen the tensioner pulley and adjust the tension of the toothed belt ⇒ [page 33](#) .
- If the tension of the toothed belt was altered, check the injection starting and adjust it if required ⇒ [page 101](#) .





## 2 Crankshaft and engine flywheel seal - remove and install



### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



### Note

*Clutch repairs ➔ 5-speed stick manual gearbox 02T; Rep. Gr. 30 ; Repair the clutch activation .*

#### 1 - Front crankshaft seal (pulley side)

- ☐ Do not lubricate nor grease the seal lip
- ☐ Prior to installation, remove oil residues from the crankshaft journal with a clean cloth
- ☐ Replace ➔ [page 17](#)

#### 2 - Front flange of the crankshaft seal (pulley side)

- ☐ Place on the fixing guides
- ☐ Install with Silicone seal -D 176 404 A2-
- ☐ Remove and install ➔ [page 20](#)

#### 3 - Engine block

- ☐ Remove and install the crankshaft ➔ [page 24](#)
- ☐ Disassemble and assemble piston and rod ➔ [page 26](#)

#### 4 - 60 Nm + 90°

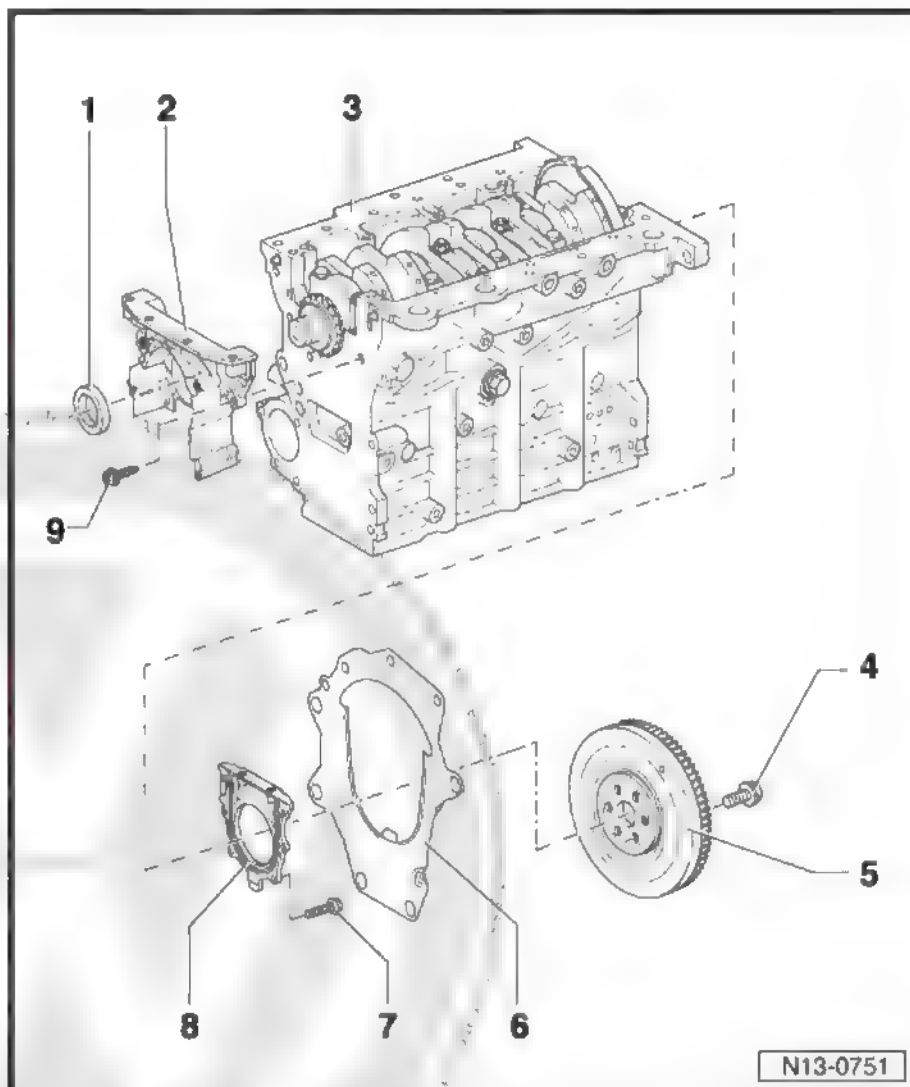
- ☐ Replace
- ☐ Additional torque may be applied in many steps

#### 5 - Steering wheel

- ☐ To remove and install, use the Flywheel lock -T 10044- and -T10044/1- ➔ [page 17](#)

#### 6 - Intermediate plate

- ☐ Place on the fixing guides
- ☐ Do not damage nor fold during installation





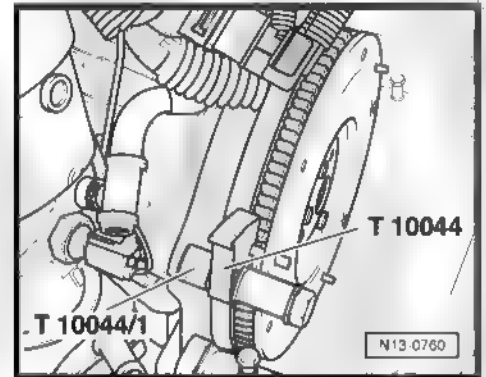
7 - 15 Nm

8 - Rear flange of the crankshaft with sealant (flywheel side)

- ☐ Only replace the whole set
- ☐ Do not lubricate nor grease the seal lip
- ☐ Prior to installation, remove oil residues from the crankshaft journal with a clean cloth
- ☐ In order to install, use the fixing guide that is supplied by the manufacturer, which can only be removed after the crankshaft sealant has been installed

9 - 15 Nm

Flywheel installation and removal



Special tools and workshop equipment required

- ◆ Flywheel lock -T 10044- with -T10044/1-

Install Flywheel lock -T 10044- with -T10044/1- to remove and install the flywheel in the engine block.

2.1 Crankshaft sealant (pulley side) replace



**WARNING**

*Always replace self-locking nuts and screws which were subjected to angular torque.*



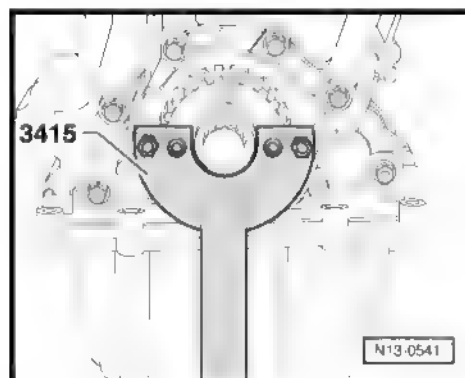
Special tools and workshop equipment required

- ◆ Extractor -3203-
- ◆ Wrench -3415-
- ◆ Assembly sleeve -T 10053-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Torquemeter - 40 to 200Nm (socket 1/2") -VAG 1332-



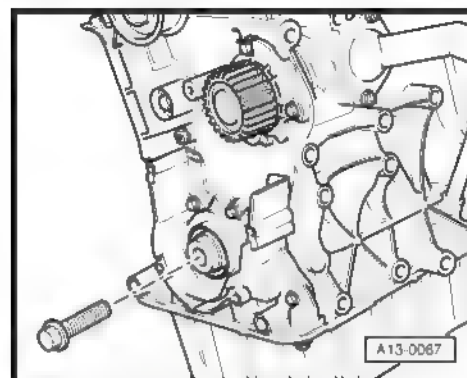
## 2.1.1 Removal

- Remove front left wheel housing liner ⇒ Body - external mountings; Rep. Gr. 66 ; Wheel housing liner - remove and install .
- Remove Poly-V belt ⇒ [page 14](#) .
- Remove the toothed belt ⇒ [page 33](#) .
- Remove the crankshaft gear. To do so, lock the gear with Wrench -3415- .

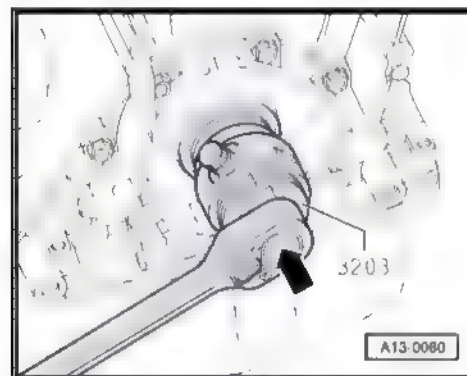




- To guide the Extractor -3203- of the sealer, tighten the gear fastening screw to the limit on the crankshaft.
- Extract the outer element by turning it twice, the inner element of Extractor -3203- (approx 3 mm) and immobilize it with the grooved screw.



- Lubricate the threaded element of Extractor -3203- , and position it by pressing it firmly and tightening it to the maximum possible extent on the sealant.
- Release the splined screw and turn the inner element against the crankshaft until the seal is extracted.



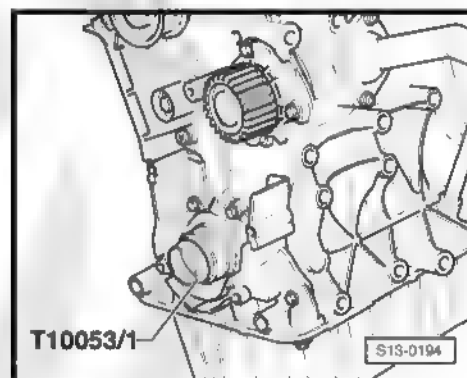
## 2.1.2 Installation



### Note

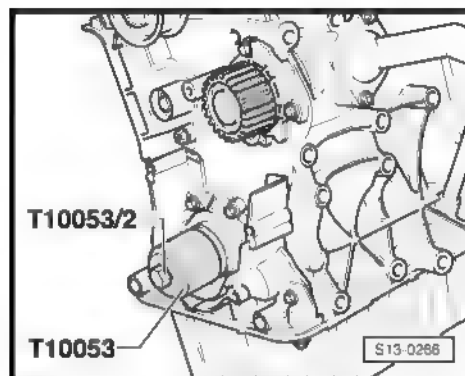
*The oil seal lip shall not be additionally lubricated or greased.*

- Prior to installation, remove oil residues from the crankshaft journal with a clean cloth.
- Prior to installing, remove oil residues on the crankshaft journal with a clean cloth.
- Slide oil seal over Guide sleeve -T10053/1- over the crankshaft journal.

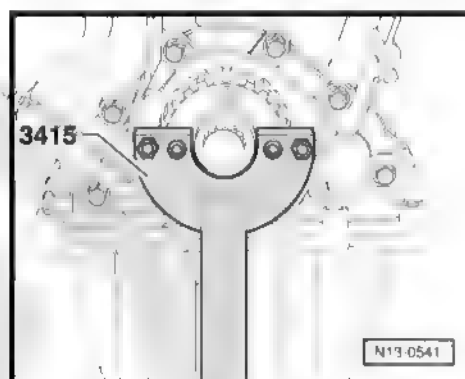




- Compress the seal to the stop using the Assembly sleeve - T10053- and Central screw -T10053/2 - or the Central screw -T10053/3- .



- Install the crankshaft gear. To do so, lock the gear with Wrench -3415- . Tightening torque: 120 Nm + 90°.
- Remove the toothed belt ⇒ [page 33](#) .
- Install the Poly-V belt ⇒ [page 14](#) .
- Install the left front wheel case protection ⇒ Body - external mountings; Rep. Gr. 66 ; Wheel housing liner - remove and install .



## 2.2 Front flange of the crankshaft (pulley side) - remove and install



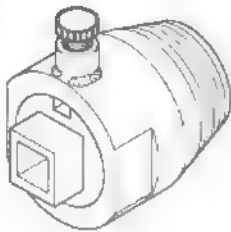
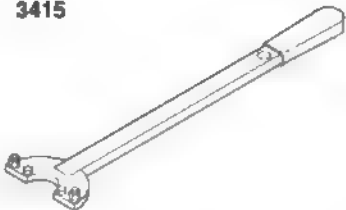
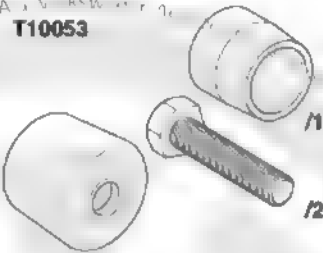


### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



#### Special tools and workshop equipment required

- ◆ Extractor -3203-
- ◆ Wrench -3415-
- ◆ Assembly sleeve -T 10053-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Torquemeter - 40 to 200Nm (socket 1/2") -VAG 1332-

<p><b>3203</b></p> 	<p><b>3415</b></p> 
<p><b>T10053</b></p> 	<p><b>V.A.G 1331</b></p> 
<p><b>V.A.G 1332</b></p> 	<p><b>W13-0100</b></p>

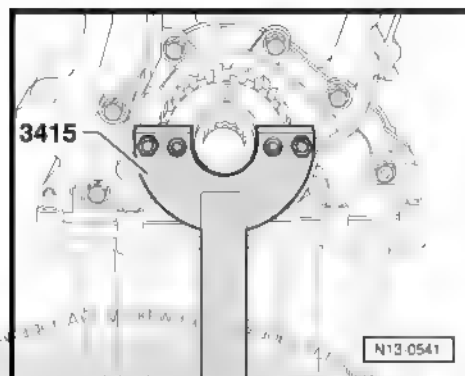
- ◆ Portable drill with plastic brush
- ◆ Silicone seal -D 176 404 A2-

#### 2.2.1 Removal

- Remove front left wheel housing liner ⇒ Body - external mountings; Rep. Gr. 66 ; Wheel housing liner - remove and install .
- Remove Poly-V belt ⇒ [page 14](#) .
- Remove the toothed belt ⇒ [page 33](#) .



- Remove the crankshaft gear. To do so, lock the gear with Wrench -3415- .
- Drain the engine oil.
- Remove sump ➔ [page 59](#) .
- Remove the seal flange and release it, if necessary, by slightly hitting it with a rubber hammer.
- Eliminate all seal residues that may be on the engine block with a spatula.



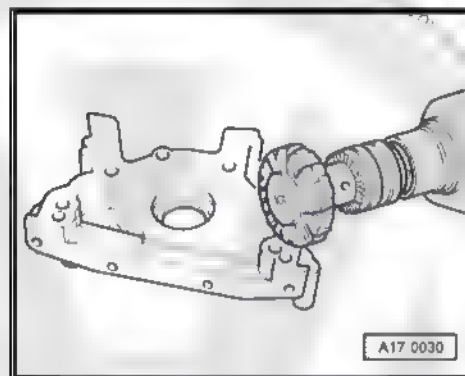
- Remove the seal residues from the flange with rotational plastic brush installed on the drill.



#### WARNING

*Wear safety goggles!*

- Clean the seal surfaces, which shall be free from oil and grease.



## 2.2.2 Installation



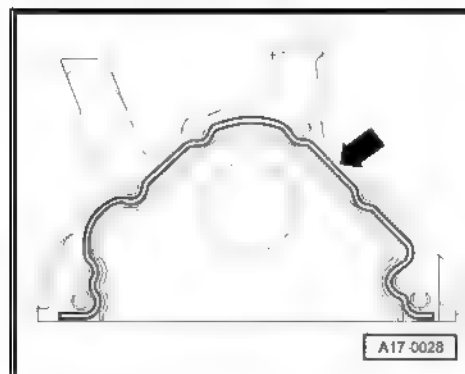
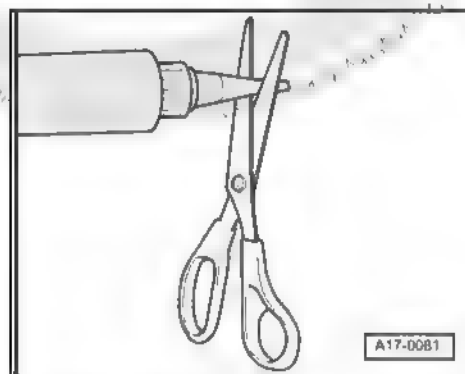
#### Note

- ◆ *Observe the validity date of the Silicone seal -D 176 404 A2- .*
- ◆ *Install the flange 5 minutes after application of the Silicone seal -D 176 404 A2- .*
- Cut the tube applicator at the front mark ( of the injector is approx. 3 mm).



#### Note

- ◆ *The silicone string shall not be thicker, otherwise silicone in excess may drop from the oil sump and clog the oil suction pipe strainer.*
- ◆ *Prior to applying sealant, cover the seal surface with a clean cloth.*
- Apply the Silicone seal -D 176 404 A2- to the sealing surface of the flange, as indicated.
- Place the flange immediately and slightly tighten the screws.





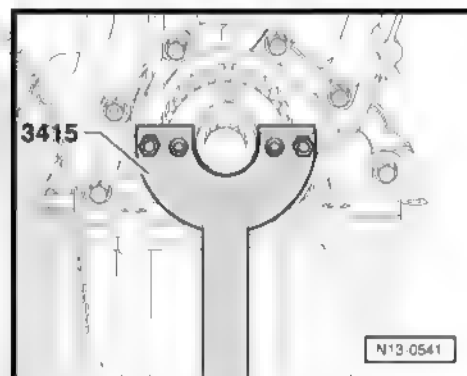
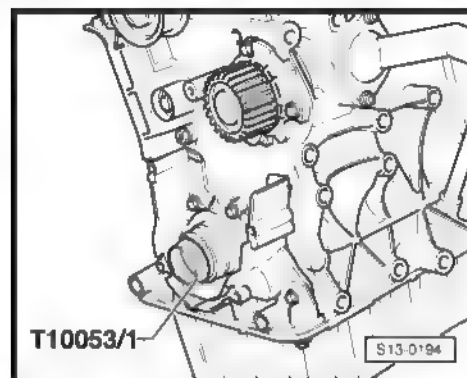
- Use the Guide sleeve -T10053/1- to position the flange with the seal
- Tighten flange fastening screws crosswise to a torque of 15 Nm.
- Install the oil sump → [page 59](#) .



#### Note

*The sealant shall cure for approx. 30 minutes after installation. Only after this period of time can the engine be supplied with oil.*

- Install the crankshaft gear. To do so, lock the gear with Wrench -3415- . Tightening torque: 120 Nm + 90°
- Remove the toothed belt → [page 33](#) .
- Install the Poly-V belt → [page 14](#) .
- Install the left front wheel case protection ⇒ Body - external mountings; Rep. Gr. 66 ; Wheel housing liner - remove and install .





### 3 Crankshaft - remove and install



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

#### 1 - Bearing shells 1, 2, 4 and 5

- ☐ For bearing covers without lubrication grooves
- ☐ For the engine block with lubrication grooves
- ☐ Neither mix nor reuse used bearing shells (mark them)

#### 2 - 65 Nm + 90°

- ☐ Replace
- ☐ In order to measure radial clearance, tighten with 65 Nm without additional torque

#### 3 - Bearing cover

- ☐ Bearing cover 1: Pulley side of the crankshaft
- ☐ Cap 3 with housing for adjustment rings
- ☐ The locks of the bearing shells of the engine block and covers shall coincide

#### 4 - Bearing shell 3

- ☐ For bearing covers without lubrication grooves
- ☐ For engine block with lubrication groove
- ☐ Neither mix nor reuse used bearing shells (mark them)

#### 5 - Adjustment rings

- ☐ For bearing cover 3
- ☐ Check fastening

#### 6 - Rotor

- ☐ For Engine speed sender -G28-

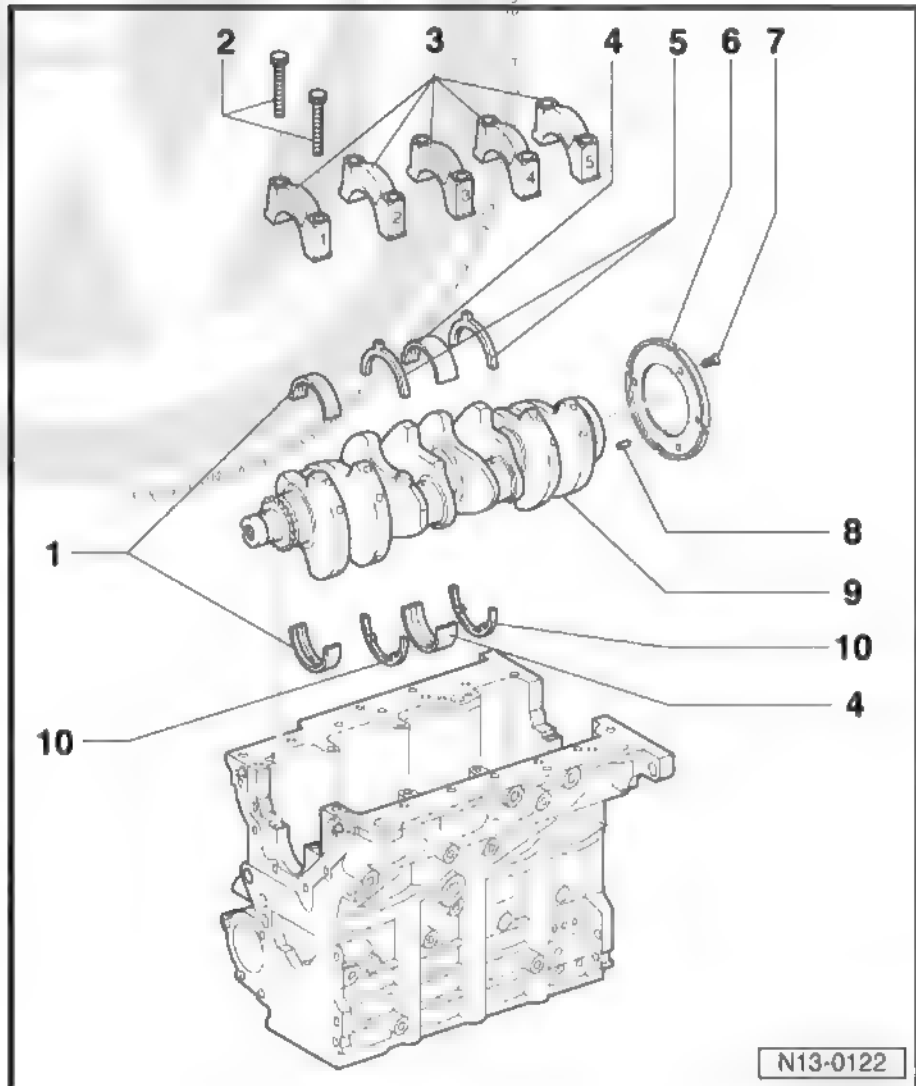
#### 7 - 10 Nm + 90°

- ☐ Replace

#### 8 - Adjustment pin

#### 9 - Crankshaft

- ☐ New axial clearance: 0.07...0.17 mm wear limit: 0.37 mm
- ☐ Measure radial play with "Plastigage": new: 0.03...0.08 mm wear limit: 0.17 mm
- ☐ Do not turn the crankshaft during measurement of the radial clearance
- ☐ Crankshaft measurements → [page 24](#)



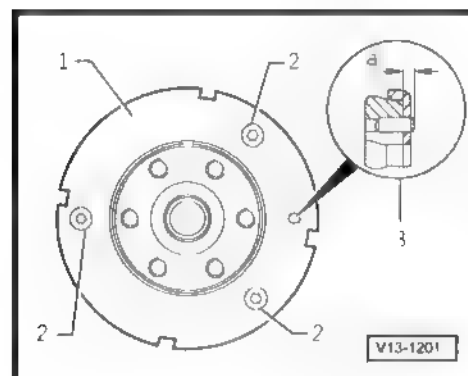


## 10 - Adjustment ring

- ☐ For engine block, bearing 3

Check the protuberance of the crankshaft adjusting pin

- 1 - Steering wheel
  - 2 - Fixing screw
  - 3 - Adjusting pin protuberance  $a = 2.5...3.0$  mm
- Check protuberance -nd- of the crankshaft adjustment pin with the flywheel -1- removed.



## 3.1 Crankshaft measurements

(measurements in mm)

Grinding measurement	Crank shaft bearings Stud-Ø	Rod bearing - Bearing journal-Ø
Basic measure	-0,022 54,00 -0,042	-0,022 47,80 -0,042
First grinding	-0,022 53,75 -0,042	-0,022 47,55 -0,042
Second grinding	-0,022 53,50 -0,042	-0,022 47,30 -0,042
Third grinding	-0,022 53,25 -0,042	-0,022 47,05 -0,042



## 4 Piston and rods - disassemble and assemble



### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

#### 1 - Compression rings

- ☐ Displace the openings in 120°
- ☐ Remove and install with ring pliers
- ☐ The mark "TOP" must face piston crown
- ☐ Check the opening between the gap openings ⇒ [page 27](#)
- ☐ Check the clearance of the ring in the piston slot ⇒ [page 28](#)

#### 2 - Piston

- ☐ With combustion chamber
- ☐ Mark the installation position and cylinder correspondence
- ☐ Piston/cylinder installation position ⇒ [page 29](#)
- ☐ The arrow on the piston head points to the belt pulley side
- ☐ Install using a piston ring clamp
- ☐ Replace the piston in case it is cracked
- ☐ Check piston position on upper part ⇒ [page 29](#)

#### 3 - Piston pin

- ☐ In case of difficulties while removing, heat the piston to 60 °C
- ☐ Remove and install with Puller and Installer -VW 222-

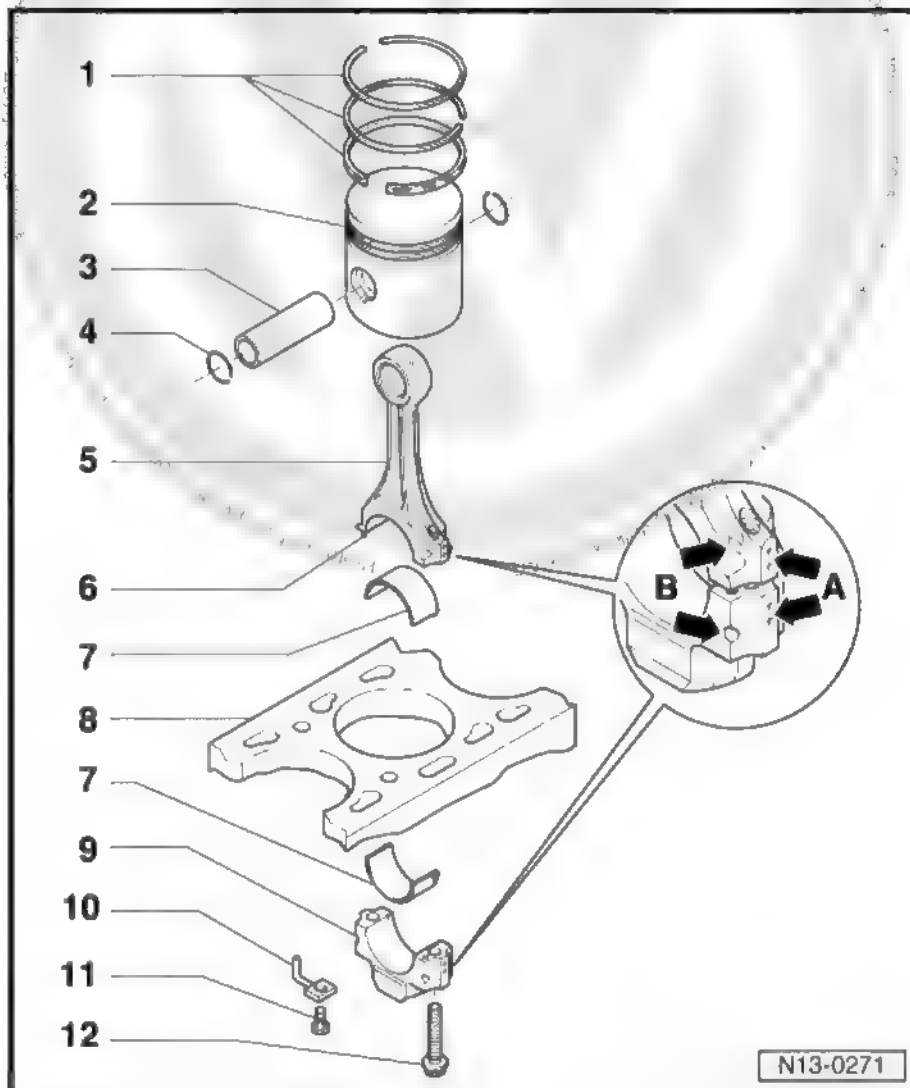
#### 4 - Latch

#### 5 - Rod

- ☐ Only replace the whole set
- ☐ Mark correspondence to cylinder -A-
- ☐ Assembly position: markings -B- point to flywheel side

#### 6 - Adjustment pin

- ☐ The adjusting pin shall be firmly positioned on the rod





#### 7 - Bearing shell

- ☐ Observe assembly position
- ☐ Do not mix used bearing shells
- ☐ Watch for proper seat on the retaining protuberances
- ☐ Axial clearance wear limit: 0.37 mm
- ☐ Measure the axial clearance with Plastigage, wear limit: 0.08 mm. While measuring the radial clearance, do not turn the crankshaft

#### 8 - Engine block

- ☐ Check the cylinder diameter ⇒ [page 28](#)
- ☐ Measurements of pistons and cylinders ⇒ [page 30](#) .

#### 9 - Rod cap

- ☐ Watch the installation position

#### 10 - Oil ejector

- ☐ For piston cooling

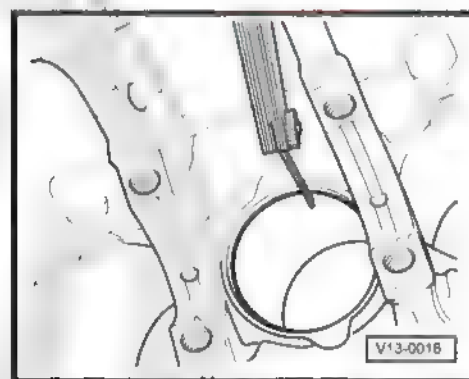
#### 11 - 25 Nm

- ☐ Install without seal

#### 12 - Rod screw

- ☐ 30 Nm + 90°
- ☐ Replace
- ☐ Lubricate the thread and the support surface
- ☐ For radial clearance measurement, use the used screw

Check the opening between the end of the rings



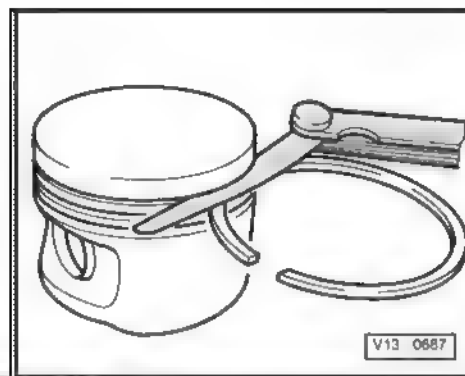
#### Special tools and workshop equipment required

- ◆ Feeler gauge
- Insert the ring in right angle from upwards to the lower opening of the cylinder with an approx. distance of 15 mm to the cylinder edge.

Piston ring	New (mm)	Wear limit (mm)
1. Compression ring	0,25...0,40	1,0
2. Compression ring	0,20...0,40	1,0
Oil scraper ring	0,25...0,50	1,0



Check the ring clearance in the piston slot



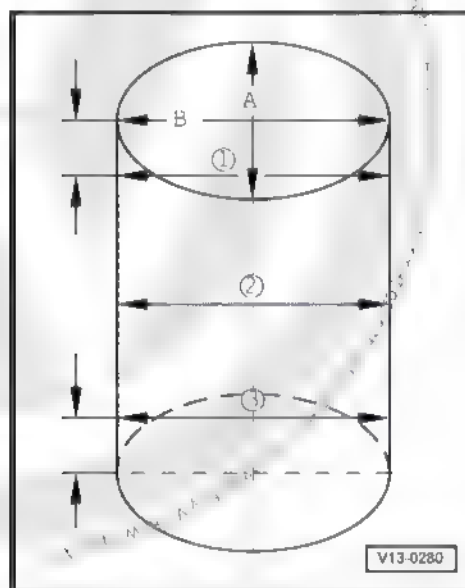
Special tools and workshop equipment required

- ◆ Blade gauge

Clean the piston groove prior to checking.

Piston ring	New (mm)	Wear limit (mm)
1. Compression ring	0,06...0,09	0,25
2. Compression ring	0,05...0,08	0,25
Oil scraper ring	0,03...0,06	0,15

Check the cylinder diameter



Special tools and workshop equipment required

- ◆ Internal micrometer 50...100 mm
- Measure in 3 distinct transversally crossed points -A- and longitudinal -B-. Deviation from nominal max. measurement 0.10 mm.



#### Note

*The cylinder's diameter cannot be measured when the engine block is placed on the assembly support with Support -VW 540-, as in this case incorrect measurements may result*

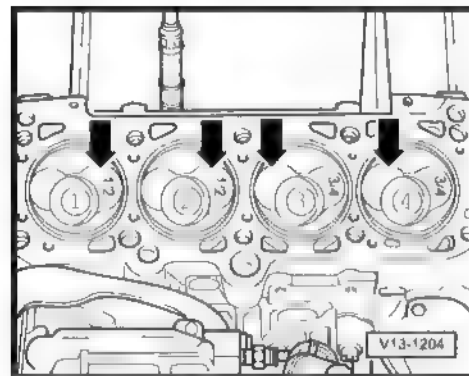
Installation position of the piston on the cylinder

Piston in cylinders 1 and 2:

Large valve seat for intake valve to the flywheel side-arrows-.

Piston in cylinders 3 and 4:

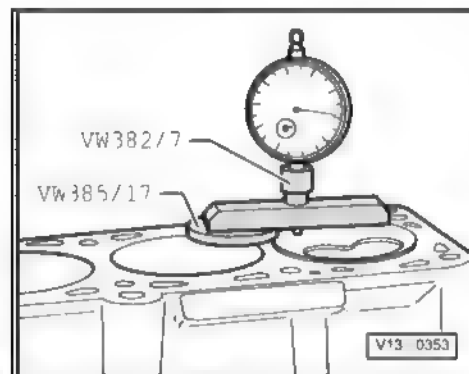
Valve large seat for intake valve to the belt pulley sidearrows-arrows-.



#### Note

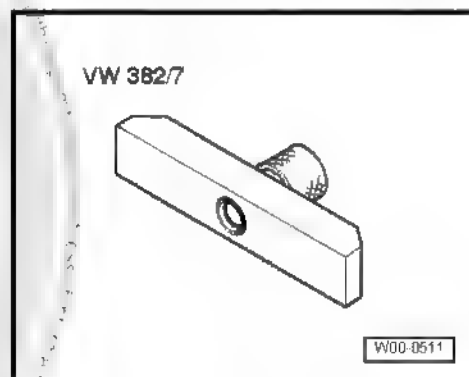
- ◆ *At new pistons the position on the cylinder is marked on the piston head with colors.*
- ◆ *Piston for cylinder 1 and 2: Marking -1/2-.*
- ◆ *Piston for cylinder 3 and 4: Marking -3/4-.*

Check the piston projection at TDC



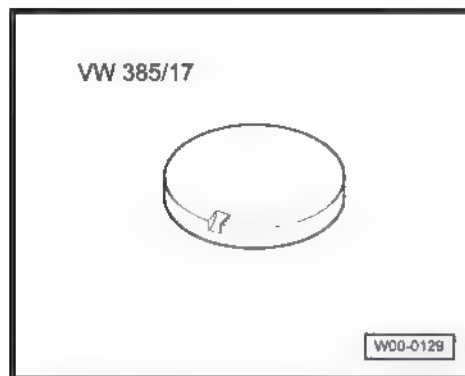
Special tools and workshop equipment required

- ◆ Measurement bridge -VW 382/7-





◆ Measurement disc -VW 385/17-



◆ Dial gauge

- The piston projection at TDC shall be measured when new pistons are installed. Depending on the piston projection, install the corresponding cylinder head gasket as follows:

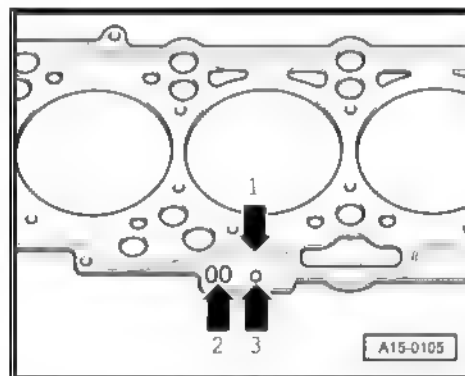
Piston projection	Identification: Holes/slots
0.91 mm ... 1.00 mm	1
1.01 mm ... 1.10 mm	2
1.11 mm ... 1.20 mm	3

Cylinder head gasket identification

- ◆ Replacement part n°: -arrow 1-
- ◆ Production control code: -arrow 2- (negligible)
- ◆ Holes:-arrow 3-



*If various values are obtained when measuring the piston projection, consider the highest value when selecting the cylinder head gasket.*



## 4.1 Measurements of pistons and cylinders

Wear measurement		Piston-Ø	Cylinder diameter-Ø
Basic measurement	mm	79,47	79,51
First grinding	mm	79,72	79,76
Second grinding	mm	79,97	80,01



## 15 – Cylinder head, Valve gear

### 1 Cylinder head - assembly overview



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

Check compression ⇒ [page 42](#) .



#### Note

- ◆ *When assembling a spare head, lubricate all contact surfaces between the support elements and the valve seats before assembling the head.*
- ◆ *The plastic packing pieces included to protect the open valves shall be removed just before installing the head.*
- ◆ *After replacement of the cylinder head, replace the coolant.*

#### 1 - Cylinder head gasket

- ☐ Replace
- ☐ Observe identification  
⇒ [page 30](#)
- ☐ After replacement, fully  
replace the coolant

#### 2 - 20 Nm

#### 3 - Engine head

- ☐ Check for warping  
⇒ [page 32](#)
- ☐ Remove and install  
⇒ [page 37](#)
- ☐ After replacement, fully  
replace the coolant

#### 4 - Lifting eyelets

#### 5 - 8 Nm

- ☐ For engine cover

#### 6 - Cylinder head fixing screw

- ☐ Replace
- ☐ Observe the assembly  
instructions and se-  
quence when loosening  
and tightening  
⇒ [page 37](#)

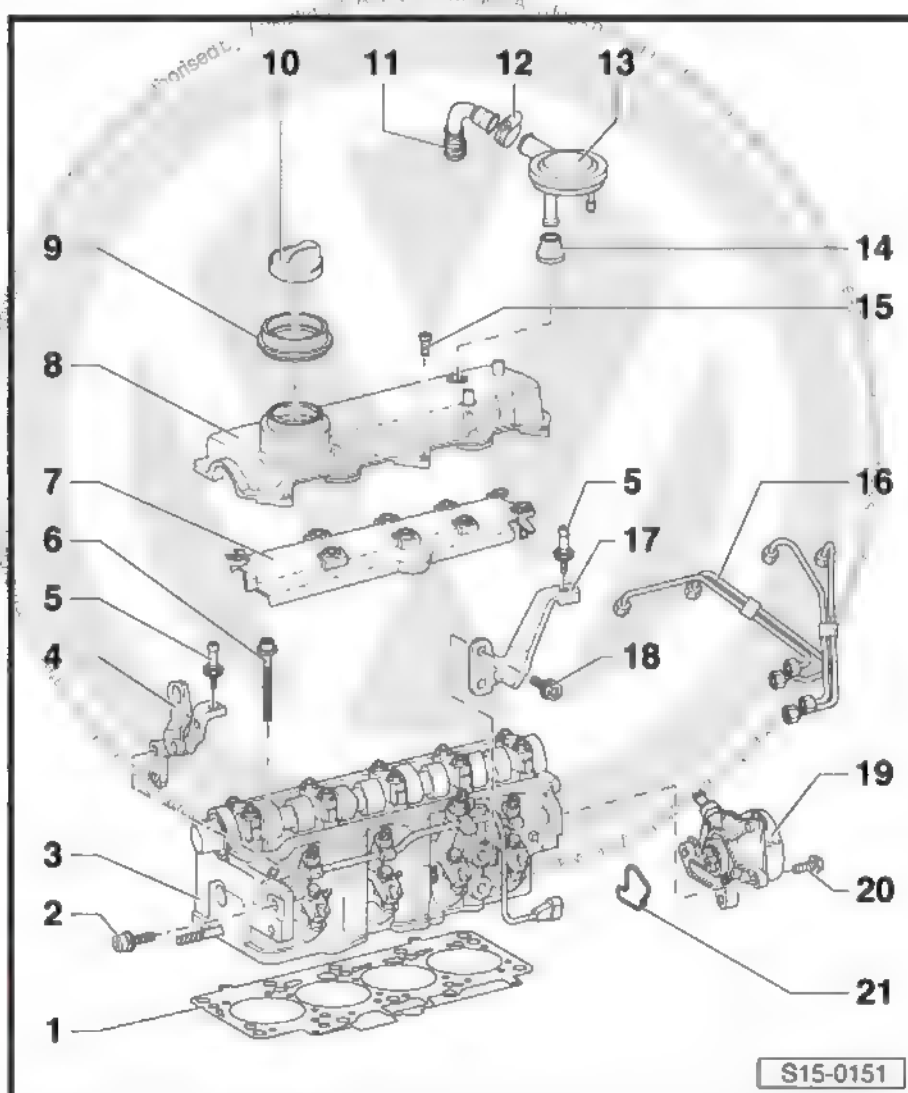
#### 7 - Oil deflector

#### 8 - Cylinder head cover

- ☐ With vulcanized seal

#### 9 - Seal ring

- ☐ Replace when dam-  
aged



S15-0151



10 - Oil filler cap

- ☐ Replace the seal if damaged

11 - Ventilation tube

12 - Clamp

13 - Pressure regulation valve

- ☐ For oil sump ventilation device

14 - Gasket

- ☐ Replace when damaged

15 - 10 Nm

16 - Injection piping

- ☐ 25 Nm
- ☐ Always remove the whole tube set
- ☐ Do not change bending

17 - Support

- ☐ For engine cover

18 - 20 Nm

19 - Vacuum pump

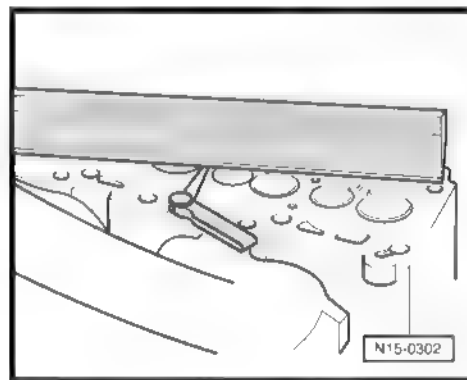
- ☐ To servo-brake

20 - 20 Nm

21 - Gasket

- ☐ Replace

Check cylinder head warp



Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Auxiliary rule

Max. permissible warp: 0.1 mm



Note

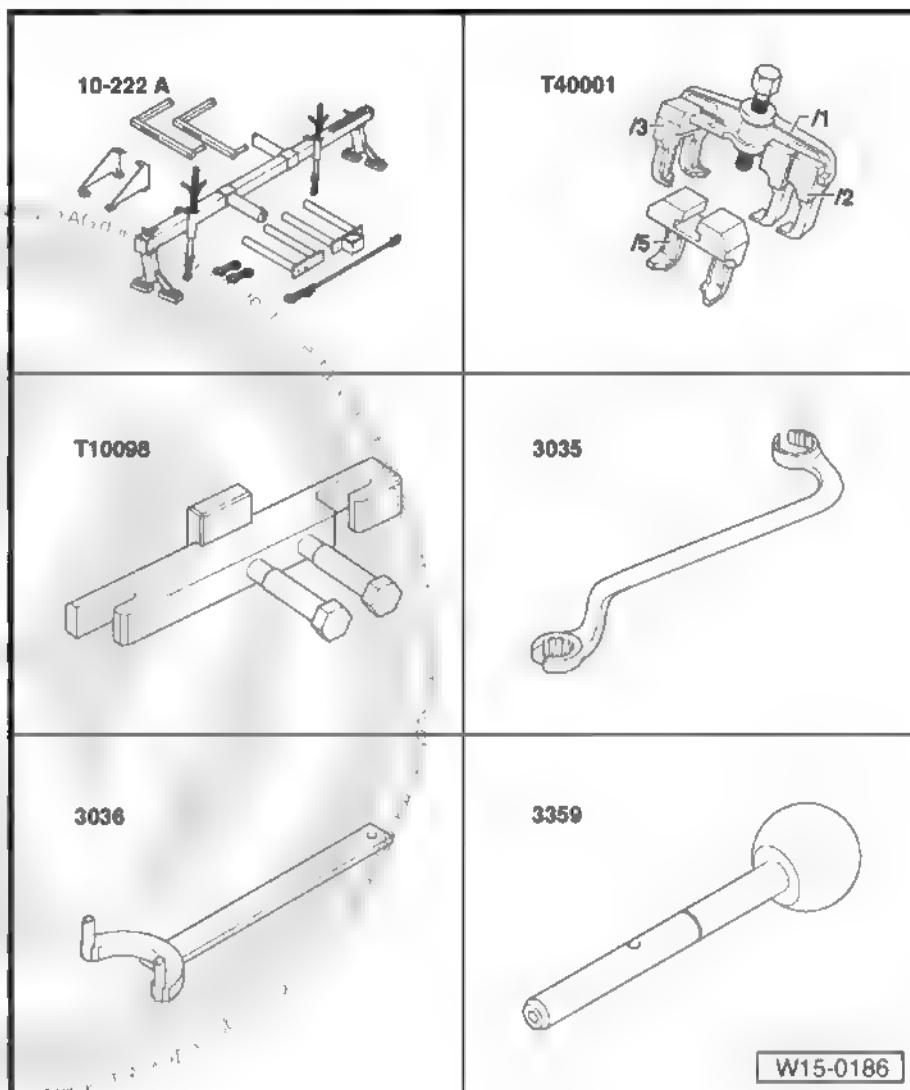
*Diesel engine cylinder head grinding is not allowed.*



## 1.1 Tooth belt - remove, install, and adjust

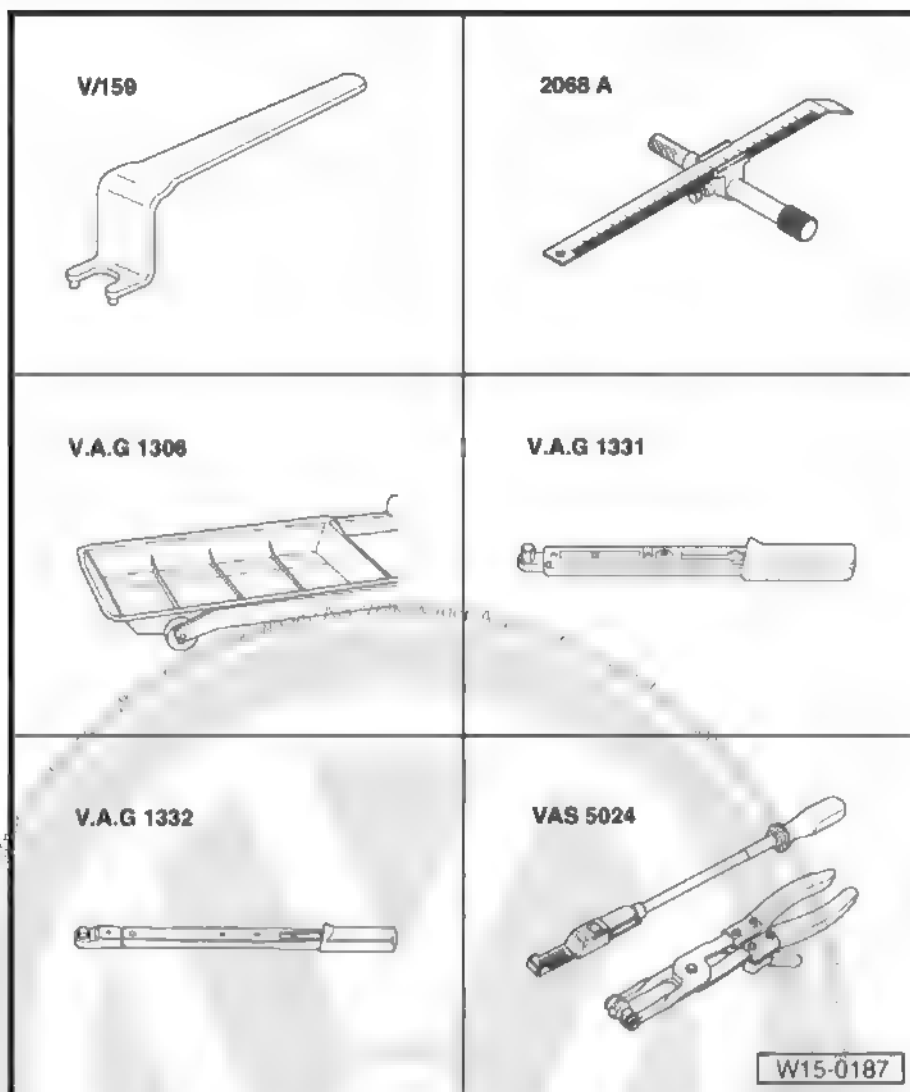
### Special tools and workshop equipment required

- ◆ Bracket or VW 061  
-10-222A- with Bracket  
-10-222A/1-
- ◆ Extractor -T 40001-
- ◆ Ruler -T10098-
- ◆ Ring spanner -3035-
- ◆ Retainer -3036-
- ◆ Lock pin -3359-



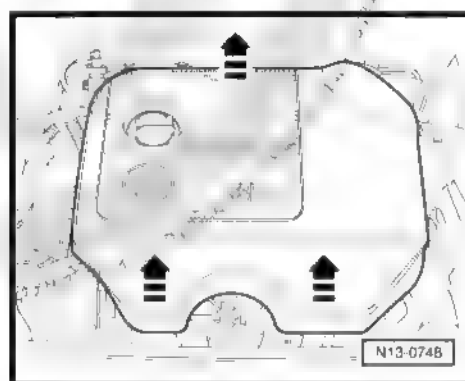


- ◆ Wrench -V 159-
- ◆ Adjustment bar -2068 A-
- ◆ Drip tray -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Torquemeter - 40 to 200Nm (socket 1/2") -VAG 1332-
- ◆ Standard type clamp pliers -VAS 5024A-



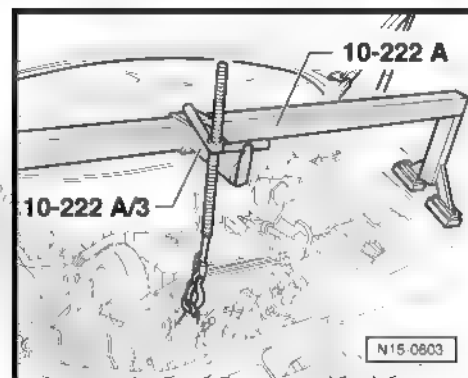
### 1.1.1 Removal

- Remove the engine cover in the direction of the arrows.
- Remove Poly-V belt ⇒ [page 14](#).
- Remove the mechanical distribution upper cover.
- Remove the vacuum pump from servo-brake.
- Remove lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50 ; Noise insulation - remove and install .





- Install the Bracket or VW 061 -10-222A- with Bracket -10-222A/1- and support the engine in its installation position.

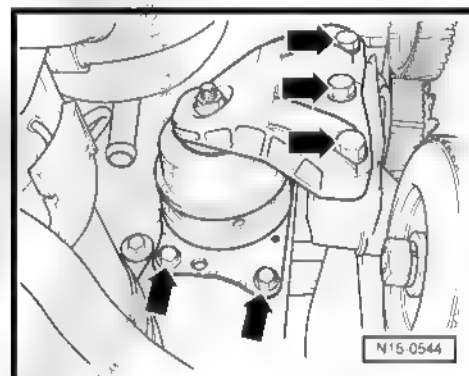


- Loosen the fastening screws -arrows- and fully remove the aggregate support.
- Remove the mechanical distribution lower cover.



#### Note

- ◆ The aggregate support may only be removed, if the engine is supported by the Bracket or VW 061 -10-222A- and with Bracket -10-222A/1-
- ◆ The engine support can only be loosened after removal of the subframe.

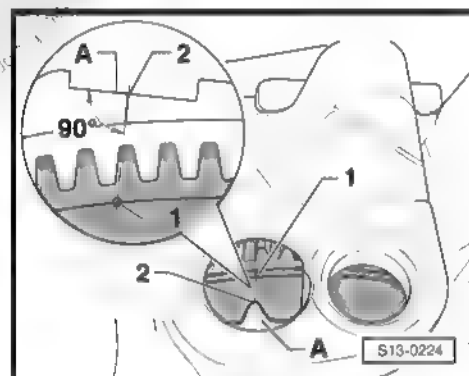


- Rotate the crankshaft to TDC of cylinder 1.
- The flywheel marking -1- must be aligned with transmission marking -2-.



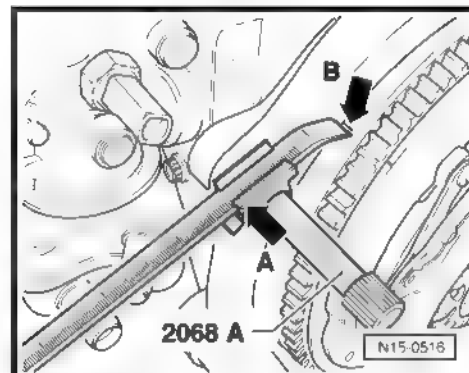
#### Note

Observe the machined surface of the transmission -A- perpendicular to the flywheel marking.



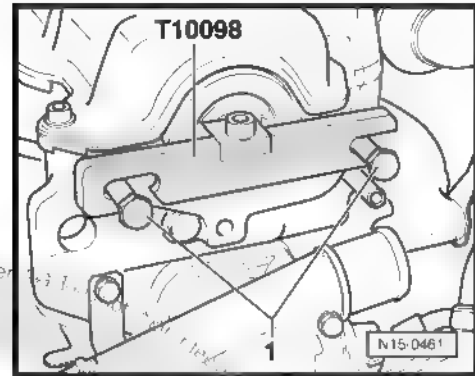
With the removed engine:

- Install the Adjustment bar -2068 A- .
- Adjust the Adjustment bar -2068 A- to 120 mm. Use the left Nonius graduation-arrow A- for reference.
- Turn the crankshaft until the TDC mark on the flywheel aligns with the adjustment device arrow B end -arrow B- of adjustment.

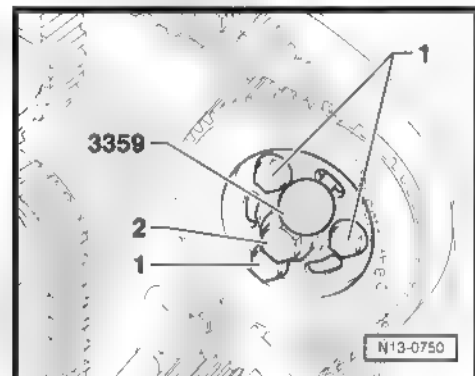




- Install the adjustment screws -1- to the stop
- Lock the crankshaft with the Ruler Ruler -T10098 -



- Lock the injection pump gear with the Lock pin -3359-.
- Loosen the screws -1- of the injection pump gear.
- Remove the strap pulley.
- Mark movement direction of the toothed belt.
- Loosen the tensioner pulley.
- Remove the toothed belt.



### 1.1.2 Installation

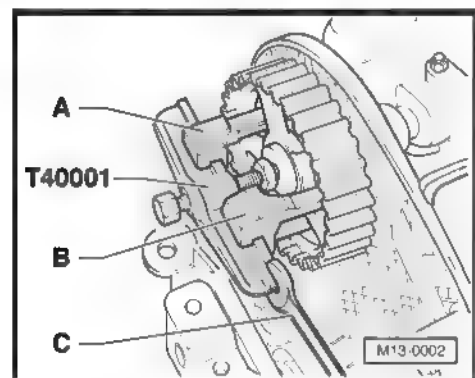
- Check whether the TDC mark is aligned with the reference mark.
- Loosen the camshaft gear screw one turn. In order to do this, secure the camshaft gear with the Retainer Retainer -3036-.



#### Note

*To loosen and tighten the camshaft gear use the Ruler -T10098- for counter support. Use the Retainer -3036- for this purpose.*

- Place the Extractor -T 40001- with The one-armed claw -T40001/2- -A- and the Two-armed claw -T40001/3- -B- centered on camshaft gear and extract. Use a wrench C as counter-support -C-.
- Place the toothed belt of crankshaft gear, deviation pulley, injection pump gear, water pump gear and tensioner pulley (observe the direction of movement).
- Center the injection pump gear onto the long holes.
- Place the crankshaft gear along with the toothed belt and fix it with a bolt (crankshaft gear remains mobile).





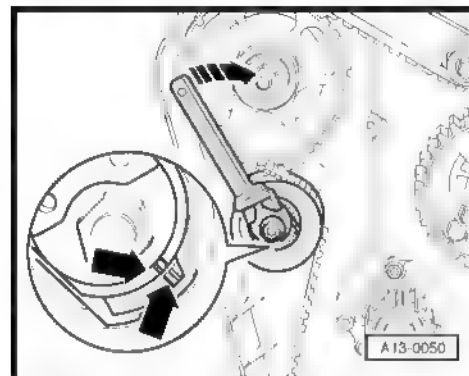
- Adjust the toothed belt. For that, turn the wrench (e.g. Mantra V159) clockwise on eccentric until the groove and elevation arrows coincide -arrows- match up.



#### Note

*In case the eccentric is advanced too far, completely loosen the tensioner pulley and tension it again. The extra turning of the eccentric cannot be returned*

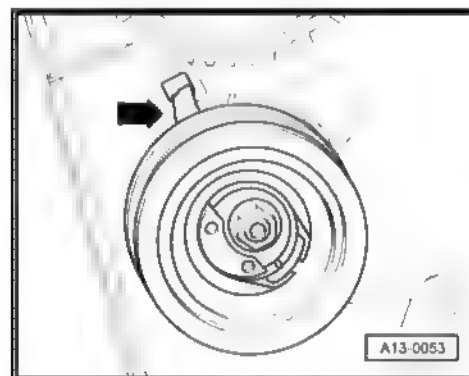
- Tighten the lock nut on the tensioner pulley with 25 Nm  
⇒ [Item 6 \(page 13\)](#) .
- Check again if the TDC on the flywheel is aligned with the reference mark.



#### Note

*Pay attention to the fastening device -arrow- for the tensioner pulley that must fit into the mechanical distribution rear protection gap.*

- Tighten the fastening screw for the camshaft gear to 45 Nm  
⇒ [Item 8 \(page 13\)](#) .
- Remove the Ruler -T10098 - .
- Remove the alignment punch.
- Turn the crankshaft twice towards the engine operation direction until it is in the TDC cylinder 1 again.
- Check the toothed belt adjustment and the belt tensioner position again.
- Install the engine support with 45 Nm.
- Install the vacuum pump from servo-brake.
- Install the mechanical distribution upper cover.
- Install Poly V belt ⇒ [page 14](#) .
- Install lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50; Noise insulation - remove and install .
- Install the engine cover.
- Perform a test drive and check the fault memory  
⇒ [page 99](#) .
- Check the injection starting and adjust it if necessary  
⇒ [page 101](#) .

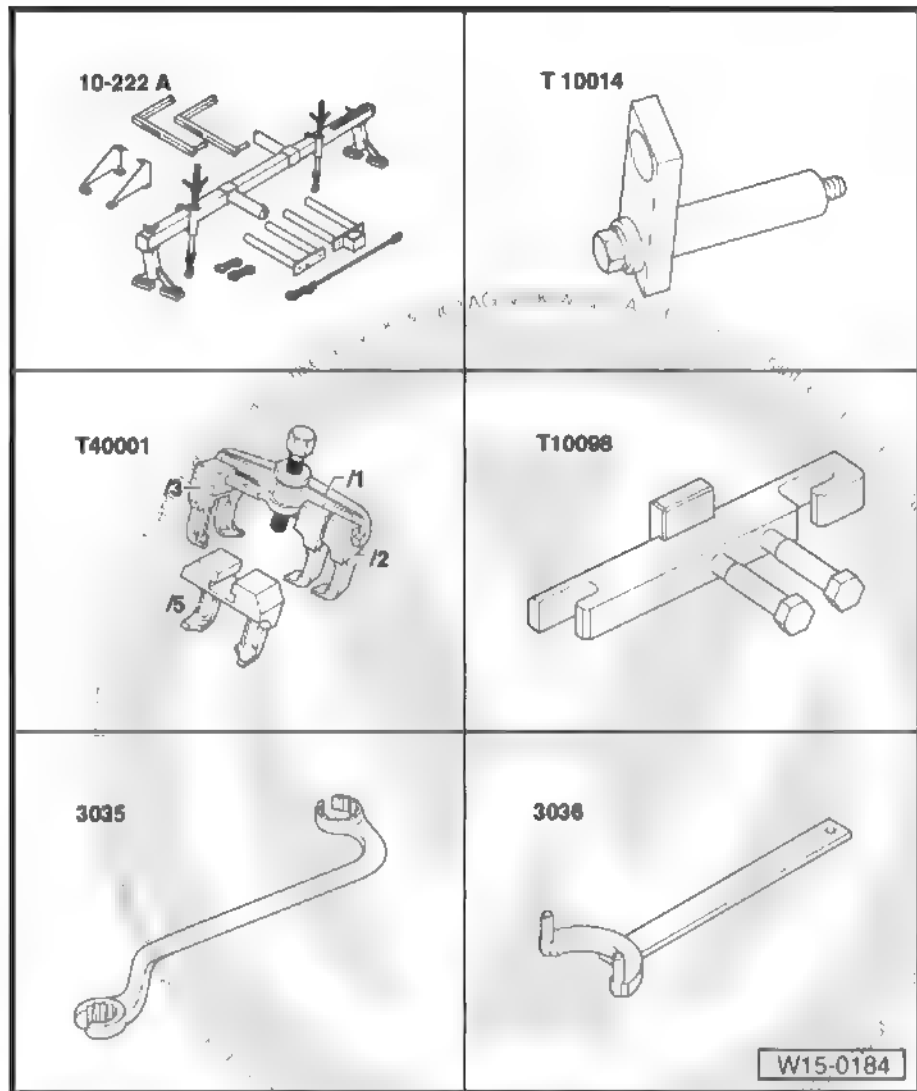


## 1.2 Cylinder head - remove and install



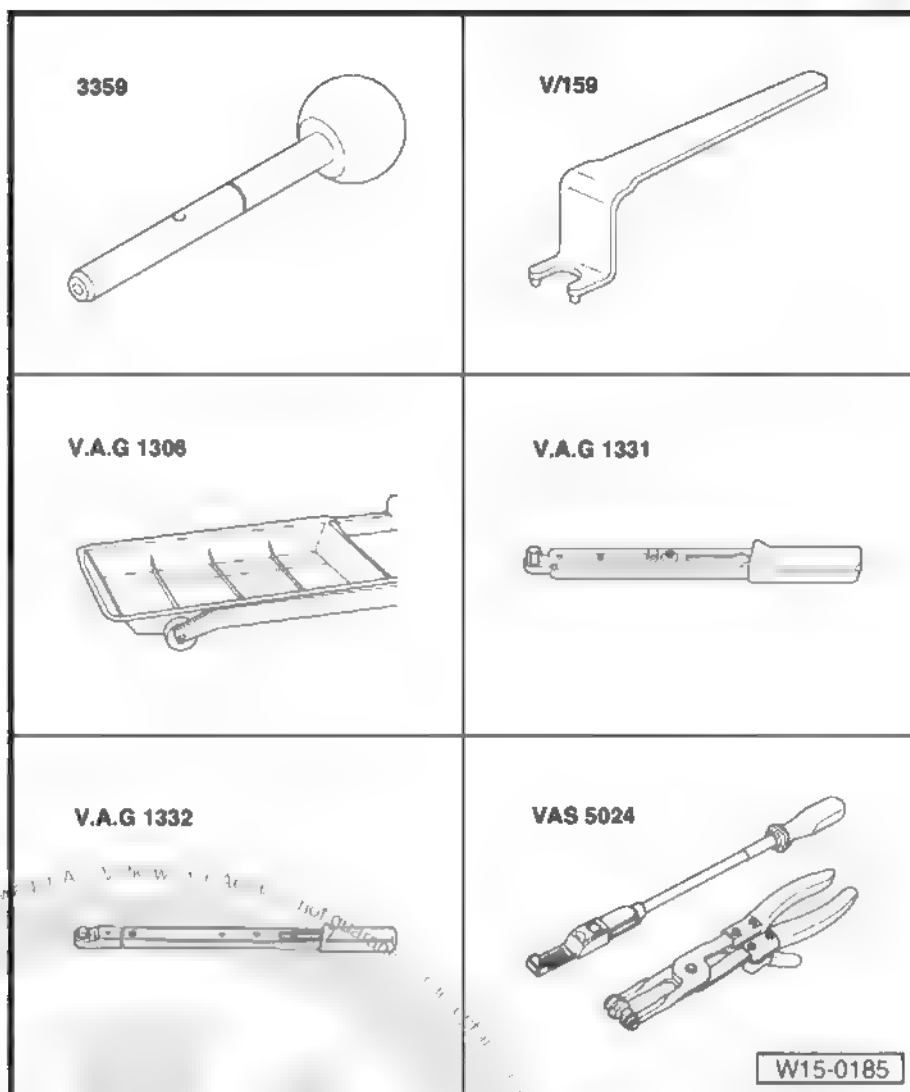
Special tools and workshop  
equipment required

- ◆ Bracket or VW 061  
-10-222A- with Bracket  
-10-222A/1-
- ◆ Support -T 10014-
- ◆ Extractor -T 40001-
- ◆ Ruler -T10098 -
- ◆ Ring spanner -3035 -
- ◆ Retainer -3036-





- ◆ Lock pin -3359-
- ◆ Wrench -V 159-
- ◆ Drip tray -VAG 1306-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Torquemeter - 40 to 200Nm (socket 1/2") -VAG 1332-
- ◆ Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A-



### 1.2.1 Removal

#### Prerequisites:

- Engine in lukewarm temperature, at maximum.
- Any pistons shall be in upper neutral position.



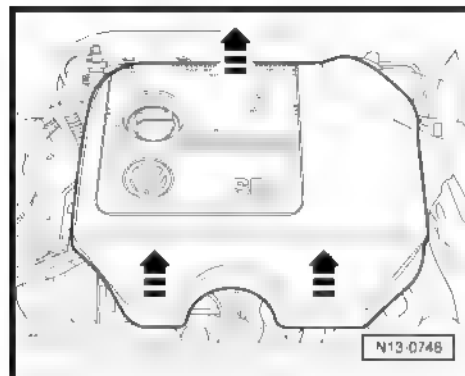
#### Note

*Check whether the vehicle has a coded radio. If so, request the anti-theft code before disconnecting the battery earth strap.*

- With the ignition switched off, disconnect the battery ground cable of Battery -A-.

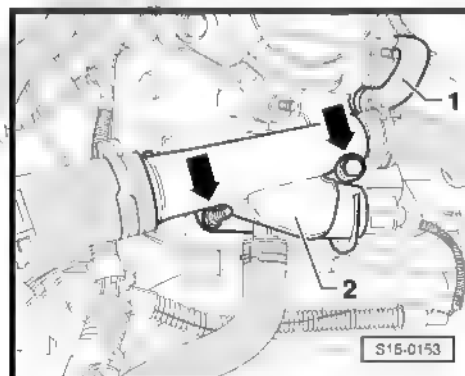
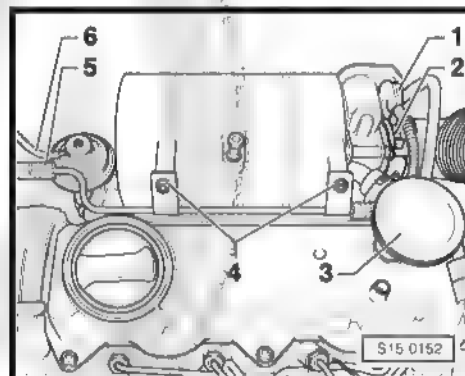


- Remove the engine cover in the direction of the arrows.
- All cable clamps that open or break during the engine removal shall be replaced and installed on the same place when installing the engine
- Remove lower engine compartment anti-rattler ➔ Body - external mountings, Rep Gr. 50 ; Noise insulation - remove and install .
- Release the exhaust pipe's manifold exhaust tube  
→ [page 102](#) .
- Drain cooling fluid ➔ [page 68](#) .
- Remove the assembly injection piping.



#### Note

- ◆ *In order to loosen all injection piping, use the Ring spanner -3035 - .*
- ◆ *Always remove the whole tube set.*
- ◆ *Do not change the bending shape.*
- Cover the openings with a clean cloth.
- Disconnect the injection return tubes/injection pump.
- Turn off the spark plug connection ruler.
- Remove the vacuum hoses from the cylinder head.
- Disconnect and release all other electrical connectors from the cylinder head.
- Remove the connector of intake tube flap -1-.
- Remove the suction tube from the flap -2-.
- Remove the pressure control valve -3- with the relief tube connected.
- Loosen the screws -4- on the intake manifold.
- Remove coolant hose -5- and the vacuum hose-6-.
- Loosen coolant connection sleeve -2- -arrows- and separate the coolant hose -1- at the distribution part.
- Remove the upper part of the mechanical distribution cover and the cylinder head cover
- Remove the vacuum pump from servo brake.





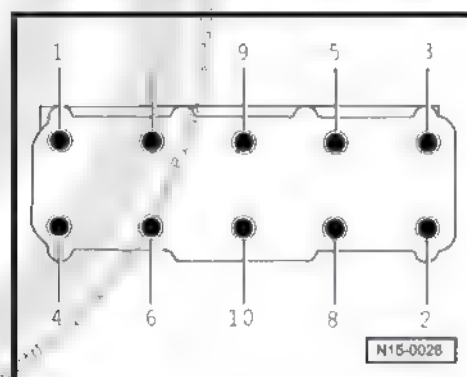
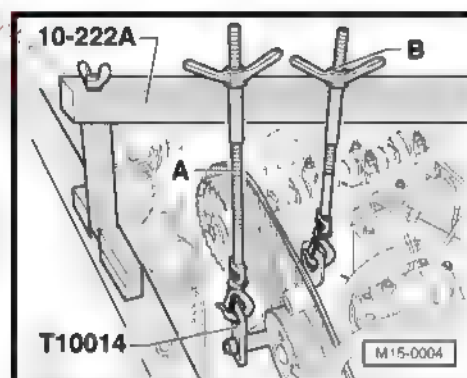
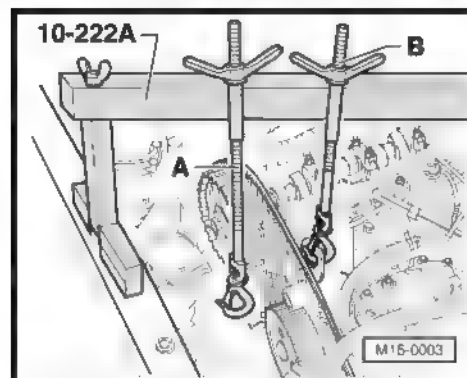
- Install the Bracket or VW 061 -10-222A- with Bracket -10-222A/1- and support the engine with the support spindle -B- in the installation position.



#### Note

*The two suspension supports are on the cylinder head and therefore another support shall be placed in order to support the engine on the block.*

- Remove Poly-V belt ⇒ [page 14](#) .
- Remove the toothed belt from the camshaft gear ⇒ [page 33](#) .
- Remove the engine support on the block ⇒ [page 38](#) .
- Install the Support -T 10014- in the fastening hole for the engine support above the water pump.
- With the second spindle -A- lift the engine until spindle -B- is released.
- Remove the tensioner pulley for toothed belt.
- Remove the screws for the mechanical distribution cover behind the cylinder head.
- Loosen the engine head screws in the indicated sequence and remove them.
- Carefully lift the engine head.



## 1.2.2 Installation

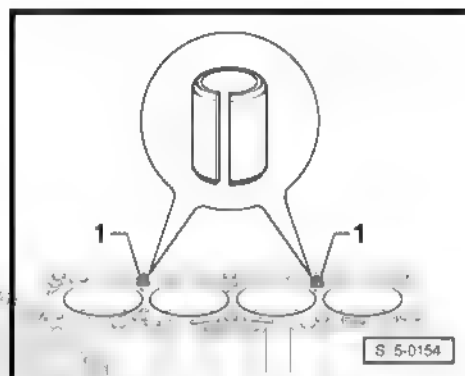


#### Note

- ◆ Regularly replace the head screws.
- ◆ In case of repairs, carefully remove joint residues between the head and the engine block. Watch that no scratches are made. In case sandpaper is used, granulation shall not be less than 100.
- ◆ Carefully remove residues that result from sanding operations.
- ◆ Just remove the head gasket from the package immediately before installing it.
- ◆ Handle the new gasket with care. If it gets damaged, it may leak.
- Place a clean cloth on the cylinders to avoid dirt or sandpaper debris entering the cylinder walls and pistons.



- Avoid dirt or sandpaper debris entering the coolant.
- Carefully clean the contact surfaces of the head and the engine block. Watch not to produce deep scratches (in case sandpaper is used, the granulation shall never be less than 100).
- Carefully remove sandpaper debris with a clean cloth.
- Check if centering pins -1- for the head are installed in the block.
- Before adjusting the cylinder head, place the crankshaft on the TDC marks.
- Turn the crankshaft to the opposite side of engine operation, until all pistons are equally on position TDC.
- Install the cylinder head gasket.
- Install the engine head by tightening the screws manually.



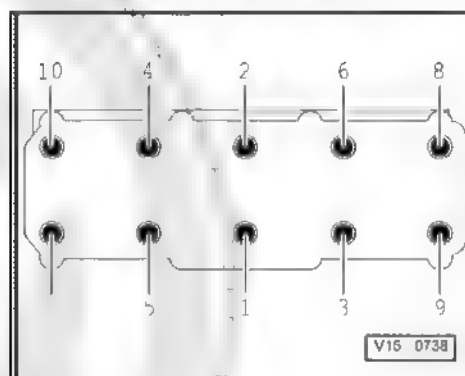
- Tighten engine head screws in four steps of the sequence shown:

- 1 - Tighten to 40 Nm
- 2 - Tighten to 60 Nm
- 3 - Turn 90° with a open-end spanner
- 4 - Turn 90°



**Note**

*Retightening the engine head screws is not necessary after repairs.*



- Continue the installation in the reverse order of removal.



**Note**

*When turning the camshaft, the crankshaft shall not be at TDC.  
Risk of damage of valves/piston heads.*

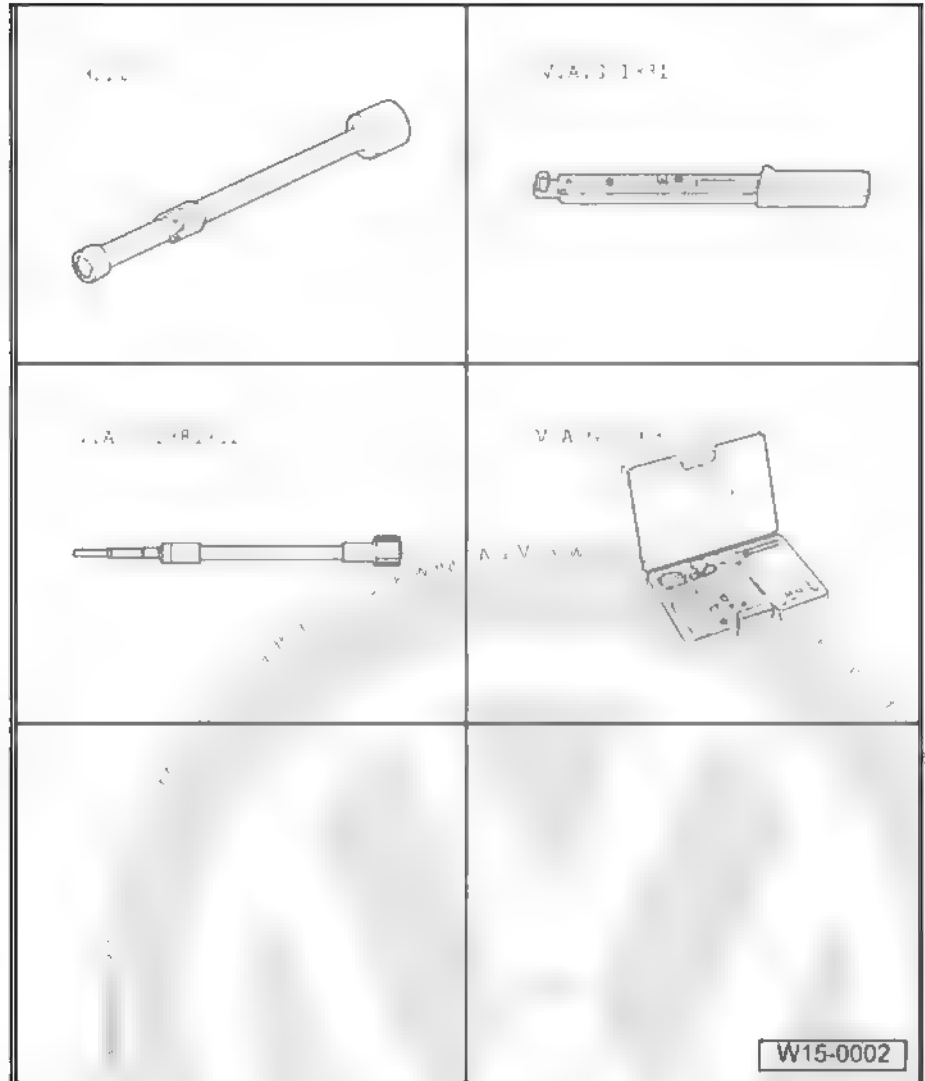
- Perform a test drive and check the fault memory  
⇒ [page 99](#) .
- Check the injection starting and adjust it if necessary  
⇒ [page 101](#) .

### 1.3 Compression - check



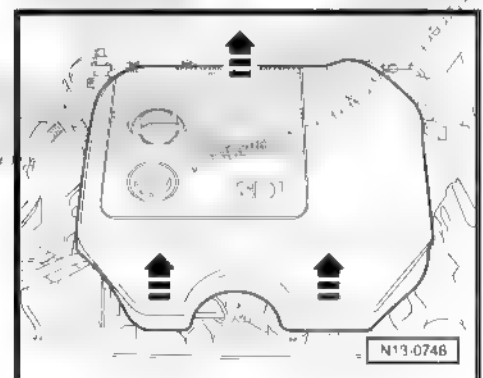
# Special tools and workshop equipment required

- ◆ Joint spanner 10 mm -3220-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-
- ◆ Adapter for VAG 1763 - VAG 1381/12-
- ◆ Compression test equipment -V A.G 1381- or Cylinder compression measurement - gasoline/alcohol -VAG 1763-



## Prerequisites:

- Engine in lukewarm temperature, at maximum.
- Any piston shall be on TDC position.
- Remove the engine cover in the direction of the arrows.
- Disconnect the 10-pole connector from the injection pump.
- Remove all spark plugs with Joint spanner 10 mm -3220-





- Install the Adapter for VAG 1763 -VAG 1381/12- instead of the spark plugs.
- Check compression with Compression test equipment -V.A.G 1381- or Cylinder compression measurement - gasoline/alcohol -VAG 1763- .



#### Note

*Operation of the testing equipment is described in the respective operation instructions.*

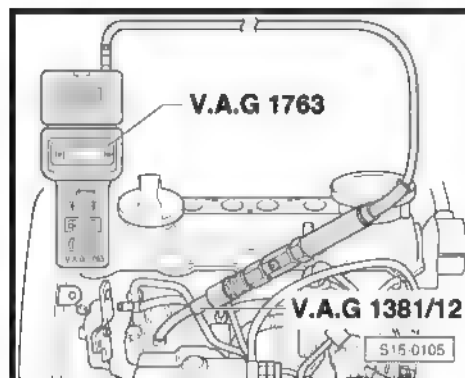
- Start the engine until the test equipment does not indicate any increase of pressure.

#### Compression values:

New: 25...31 bar. Wear limit: 19 bar

Permissible difference among all cylinders: 5 bar

- Install the spark plugs with the Joint spanner 10 mm -3220- and tighten with 30 Nm.
- Perform a test drive and check the fault memory  
⇒ [page 99](#) .





## 2 Valve mechanism - repair



### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



### Note

- ◆ *Engine heads with light cracks between valve seats can be used without lifetime reduction with maximum cracks of 0.5 mm width.*
- ◆ *Prior to the assembly work, it is necessary to lubricate the support and slide surfaces.*

### 1 - Bearing covers

- ☐ Assembly position  
⇒ [page 46](#)
- ☐ Observe removal and installation sequence  
⇒ [page 51](#)
- ☐ Lubricate the bearing 1 covers support surface with Seal paste-AMV 174 004 01-

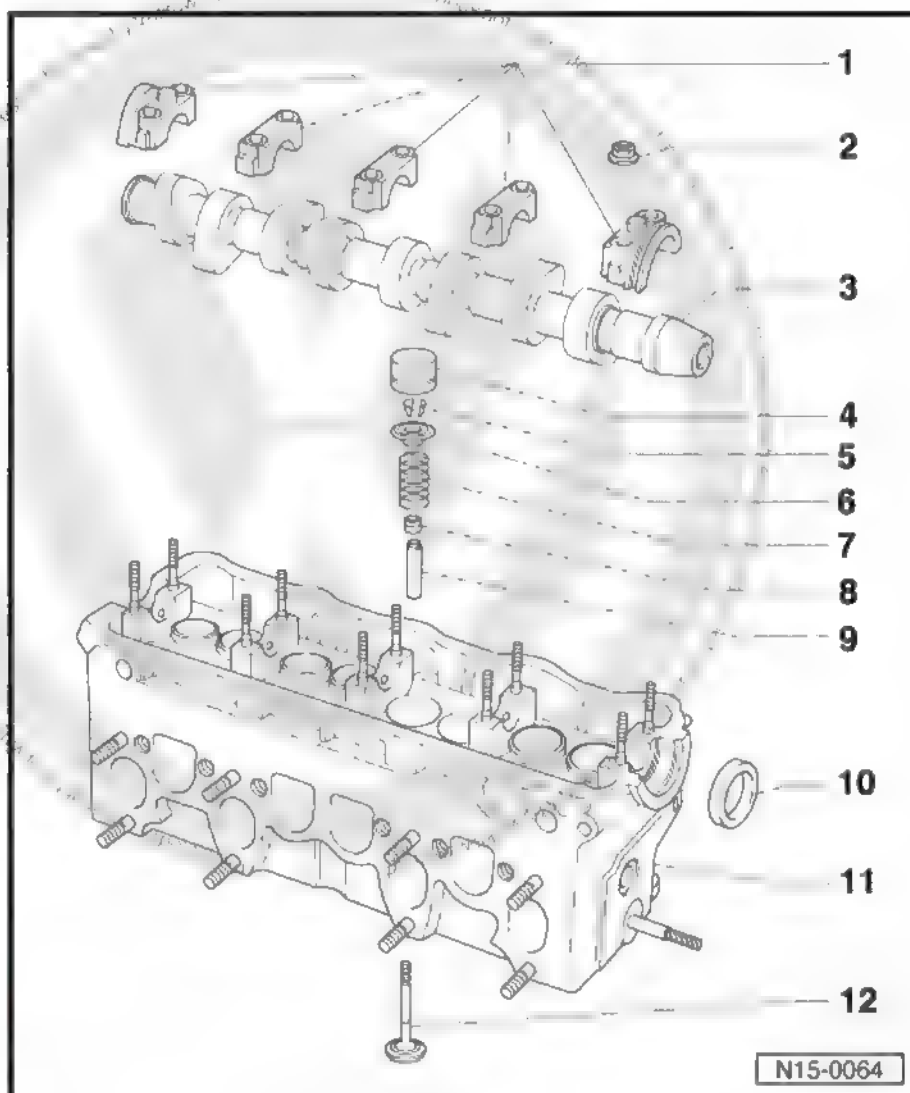
2 - 20 Nm

### 3 - Camshaft

- ☐ Check axial clearance  
⇒ [page 46](#)
- ☐ Remove and install  
⇒ [page 51](#)
- ☐ Measure radial play with "Plastigage". Wear limit: 0.11 mm
- ☐ Eccentricity: max. 0.05 mm
- ☐ Identification  
⇒ [page 47](#)

### 4 - Hydraulic tappet

- ☐ Before installation, check axial space of valve command shaft  
⇒ [page 46](#)
- ☐ Check ⇒ [page 54](#)
- ☐ Do not change
- ☐ With hydraulic offsetting of valve gap
- ☐ Place the upper part upside down
- ☐ Lubricate the contact surfaces





5 - Cotteners

6 - Valve spring plate

7 - Valve spring

8 - Valve stem seal

- ☐ Replace → [page 49](#)

9 - Valve guide

- ☐ Check → [page 49](#)

10 - Sealant

- ☐ Do not lubricate nor grease the seal lip
- ☐ Remove and install the toothed belt, adjust → [page 33](#)
- ☐ Prior to installation, remove oil residues on the camshaft pivot with a clean cloth
- ☐ In order to install the fitting on the camshaft cone, use regular adhesive tape (e.g. sellotape)

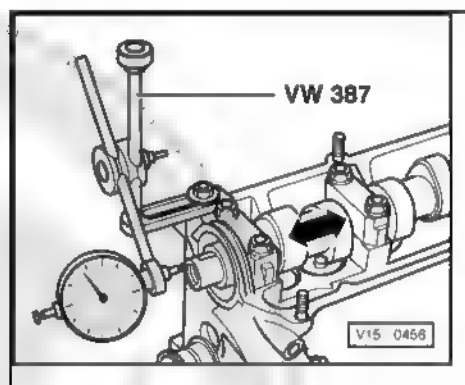
11 - Engine head

- ☐ Grind the valve seats → [page 47](#)
- ☐ Remove and install → [page 37](#)

12 - Valves

- ☐ Valve measurements → [page 47](#)
- ☐ Cannot be grinded. Only lapping-in is authorized

Check the axial clearance of the camshaft.



Special tools and workshop equipment required

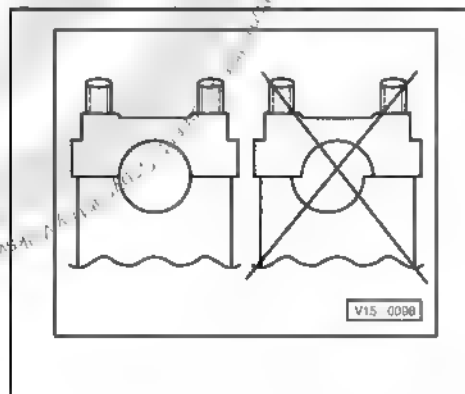
- ◆ Support -VW 387-
- ◆ Deflection meter

Measure when the tappets are removed and the first and last bearing cover are fitted.

Wear limit: max. 0.15 mm

Assembly position of the camshaft bearing cover

Check eccentricity. Prior to installation of the camshaft, place the bearing covers and check their installation position





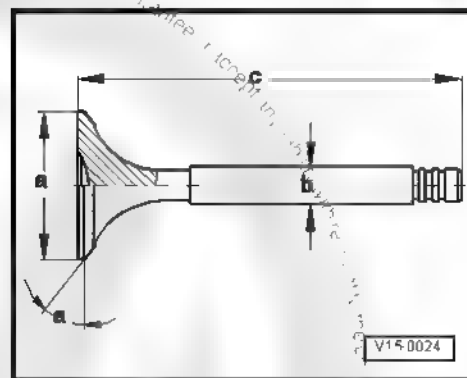
## Valve measurements



### Note

Valves cannot be ground. Only lapping-in is authorized.

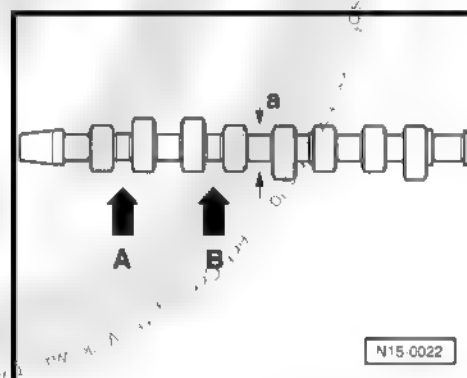
Measurement		Intake valve	Exhaust valve
$\varnothing a$	mm	35,95	31,45
$\varnothing b$	mm	6,963	6,943
C	mm	96,55	96,35
$\alpha$	$^{\circ}$	45	45



## Camshaft identification

### Identification:

- ◆ Cam base circles  $a = \varnothing 38$  mm
- ◆ Identification through numbers and letters engraved between the inlet and outlet cams:



Cylinder 1 -arrow A-	38E
Cylinder 2 -arrow B-	External diameter

## Distribution time in 1 mm valve stroke

Admission opens after TDC	11°
Admission closes after BDC	25°
Exhaust opens before BDC	40°
Exhaust closes before TDC	10°

## 2.1 Valve seats - grind

### Special tools and workshop equipment required

- ◆ Vernier caliper
- ◆ Valve seat grinding



#### Note

- ◆ Do not grind the valves. Only lapping-in is allowed.
- ◆ When repairing engines that contain leaking valves, grinding or replacing the valve seats and valves is not sufficient. Valve guides must especially be checked for wear in high mileage engines ➔ [page 49](#).
- ◆ Grind the valve seat until a correct seating pattern is shown. Calculate prior to grinding to maximum grinding measurement. If the grinding dimension is exceeded, the function of the hydraulic compensation can no longer be guaranteed and the engine head shall be replaced.

### 2.1.1 Calculate the maximum permissible-grinding measurement

- Install the valve and firmly press it against its seat.



#### Note

In case of valve replacement during repairs, use the new valve for measurement.

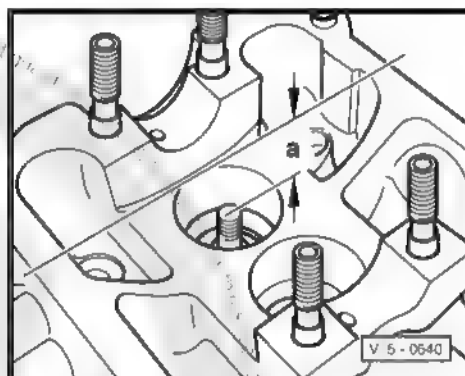
- Measure distance -nd- between the tip of the valve and the upper edge of the engine head.
- Calculate the maximum grinding dimension of the measured distance -nd- and the minimum dimension.

Minimum measurements: Intake valve 35.8 mm. Exhaust system valve 36.1 mm.

Measured distance minus minimum distance = Maximum permissible grinding measurement.

For example:

-	Measured distance	36,5 mm
	Minimum dimension	35,8 mm
=	Max. permissible measurement for grinding	0,7 mm



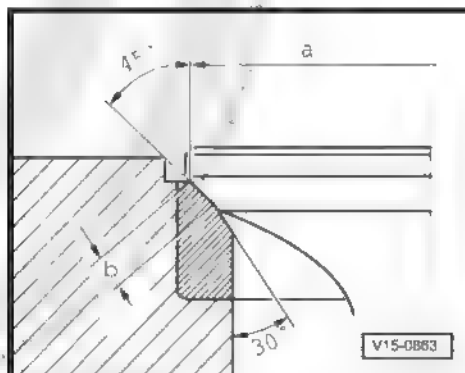
### 2.1.2 Grind the intake valve seats

- A =  $\varnothing$  35.7 mm
- B = 1.6 mm
- 45° = Valve seat angle



#### Note

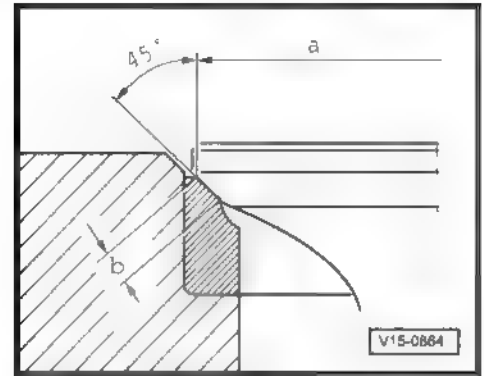
The 30° angle corresponds to the milling lowering of valve base and is absolutely necessary due to the hydrodynamic conditions at the intake channel.





### 2.1.3 Grind the exhaust valve seat

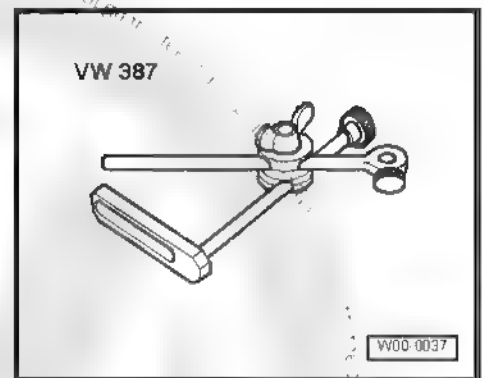
- A =  $\varnothing$  31.4 mm  
B = 2.7 mm  
45° = Valve seat angle



### 2.2 Valve guides - check

Special tools and workshop equipment required

- ◆ Support -VW 387-



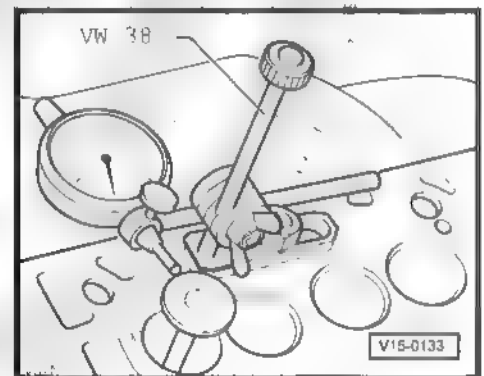
- ◆ Deflection meter

- Insert a new valve in the guide. The valve stem end shall face the guide. Due to differences on the valve stem diameter, only the intake valve on the intake guide and the exhaust valve on the exhaust guide shall be used.

- Determine the folding clearance. Wear limit: 1.3 mm

If folding space is exceeded:

- Replace the cylinder head.

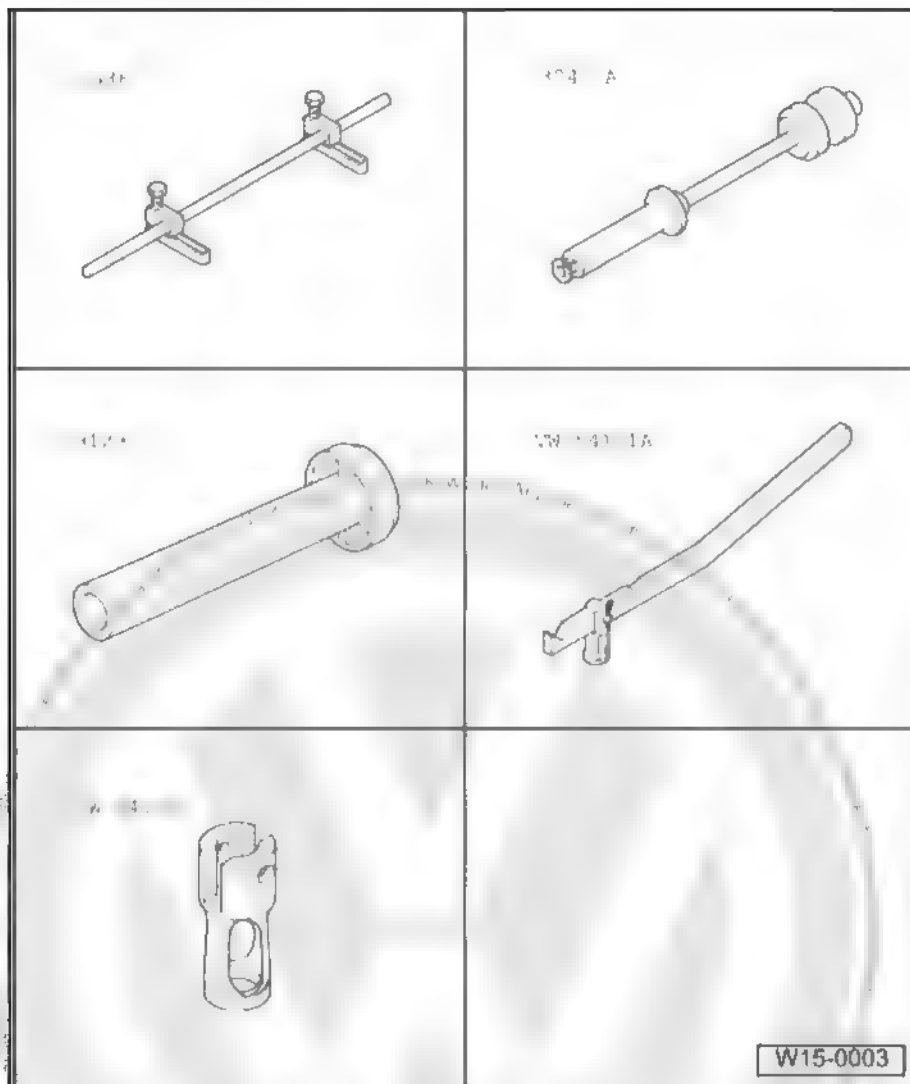


### 2.3 Valve stem seals - replace



#### Special tools and workshop equipment required

- ◆ Device -2036-
- ◆ Extractor -3047A-
- ◆ Fitting tool -3129-
- ◆ Lever -VW 541/1A-
- ◆ Press tool -VW 541/5-



### 2.3.1 Removal

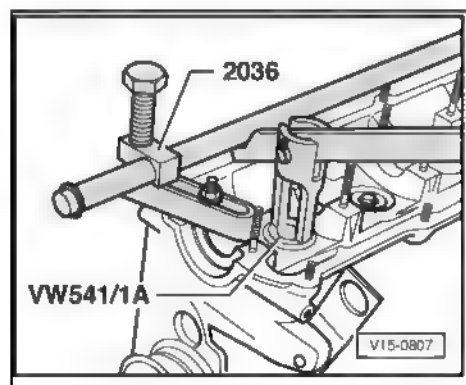
(with the cylinder head installed)

- Remove camshaft → [page 51](#) .
- Remove hydraulic taps and place them with contact surface turned downwards. Ensure that the tappets are not inverted.
- Place the piston of the respective cylinder at TDC.
- Install the Device -2036- and adjust the bearings to the height of the retaining screws.
- Remove the valve springs with Lever -VW 541/1A- and of Press tool -VW 541/5- .



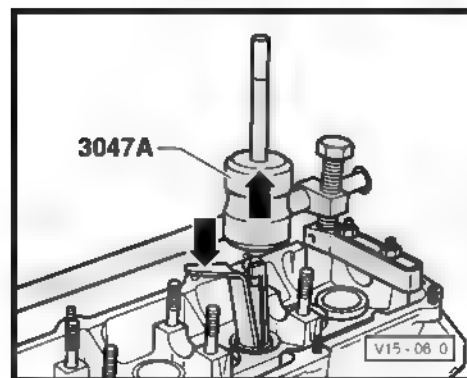
#### Note

*So the valves are supported against the piston head.*



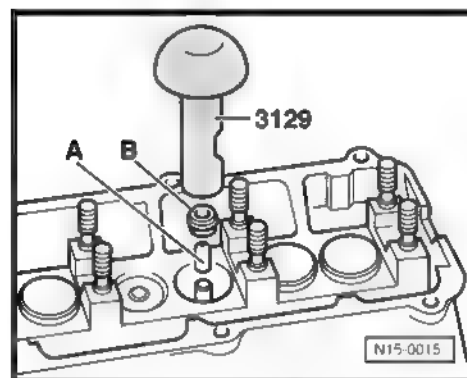


- Remove valve stem seals with the Extractor -3047A- .



### 2.3.2 Installation

- Install the plastic bushing -A- on the valve stem. This prevents damages to the new valve stem seal -B-.
- Install the new valve stem oil seal with the Fitting tool Fitting tool -3129- .
- Lubricate the oil valve stem seal lip and carefully press it onto the valve guide.

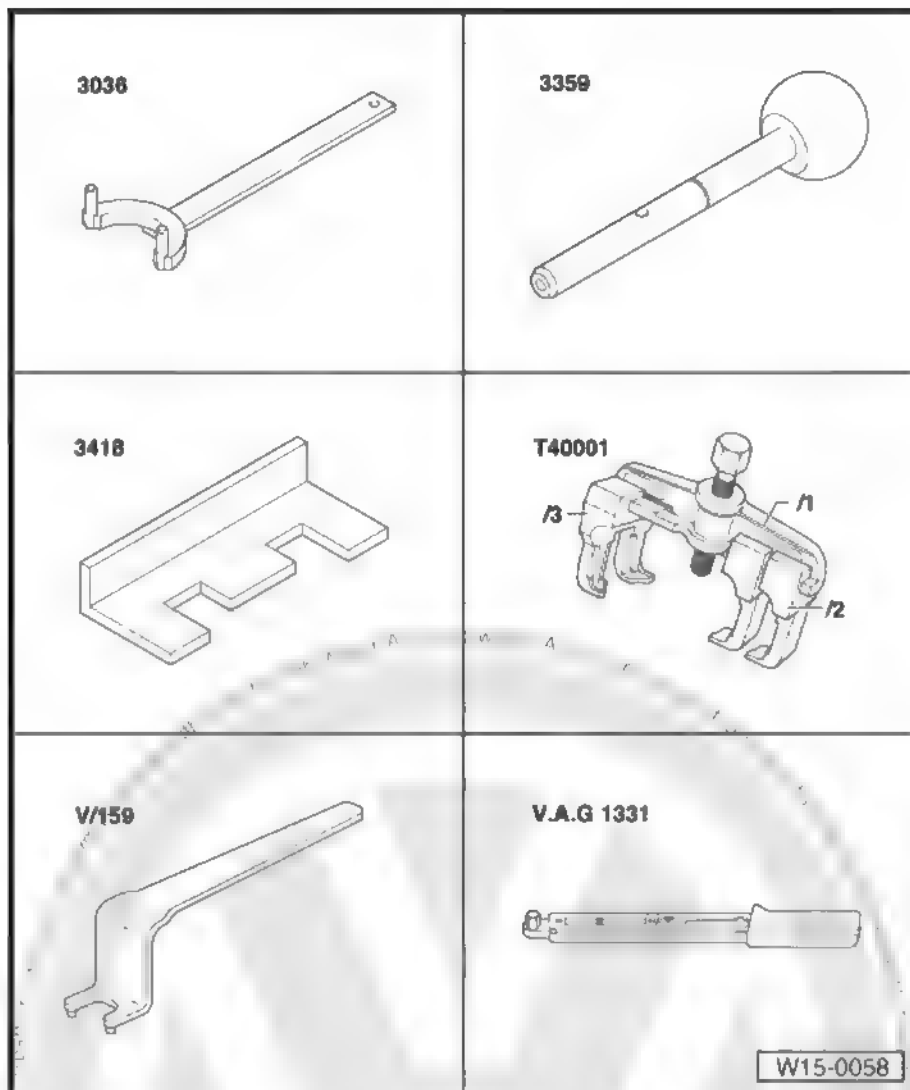


### 2.4 Camshaft - remove and install

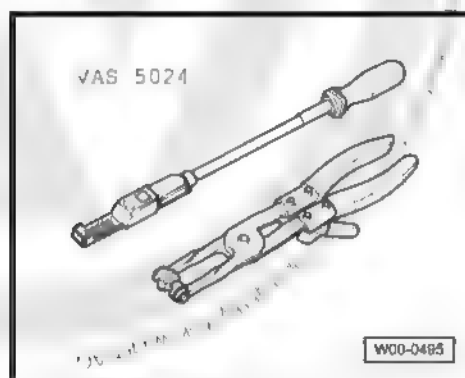


**Special tools and workshop equipment required**

- ◆ Retainer -3036-
- ◆ Lock pin -3359-
- ◆ Adjustment ruler -3418 - or Camshaft bar -T10098 -
- ◆ Extractor -T 40001-
- ◆ Wrench -V 159-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-



- ◆ Standard type clamp pliers -VAS 5024A-



- ◆ Feeler gauge
- ◆ Seal paste -AMV 174 004 01-

## 2.4.1 Removal

- Remove the mechanical distribution upper cover, the cylinder head cover and the vacuum pump
- Remove the toothed belt from the camshaft ➔ [page 33](#) .



**i** Note

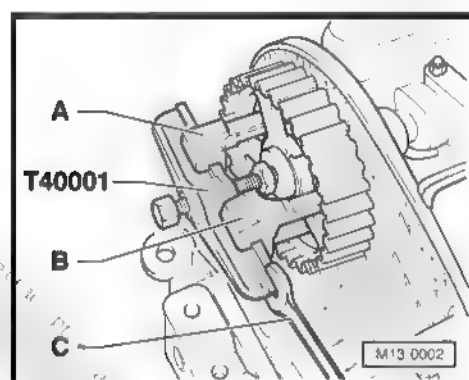
*There is no need for removing the pulley and the lower and intermediate protection of toothed belt.*

- Loosen gear screw of command shaft in one turn. In order to do this, secure the camshaft gear with the Retainer Retainer -3036-

**i** Note

*To loosen and tighten the camshaft gear use the Adjustment ruler -3418- or Camshaft bar -T10098- for counter support. Use the Retainer -3036- for this purpose.*

- Place the Extractor -T 40001- with The one-armed claw -T40001/2- -A- and the Two-armed claw -T40001/3- -B- centered on camshaft gear and extract. Use a wrench C as counter-support -C-.
- Remove the camshaft gear.
- First remove the bearing covers 5, 1 and 3. Loosen bearing covers 2 and 4 alternately and crosswise.

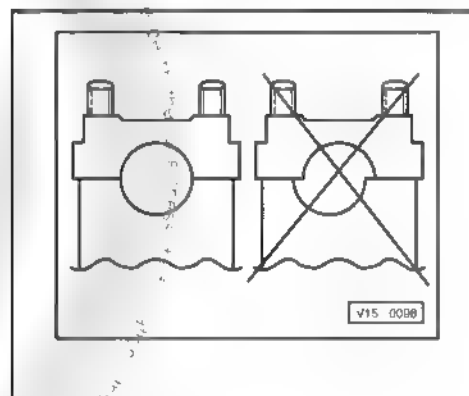


## 2.4.2 Installation

**i** Note

- ◆ *During the installation of the camshaft, the cylinder 1 cams shall face upwards.*
- ◆ *When installing the bearing covers, observe the hole eccentricity and prior to installing, place the bearing cover and check its installation position.*

- Lubricate the camshaft contact surfaces.
- Place the camshaft on the cylinder head.
- Tighten the bearings covers 2 and 4 crosswise with 20 Nm.
- Slightly lubricate the support surface of the bearing covers 1 and 5 with Seal paste -AMV 174 004 01-.
- Install the bearing covers 5, 1 and 3 and tighten them with 20 Nm.
- Place cylinder head cover 5 by slightly hitting the camshaft

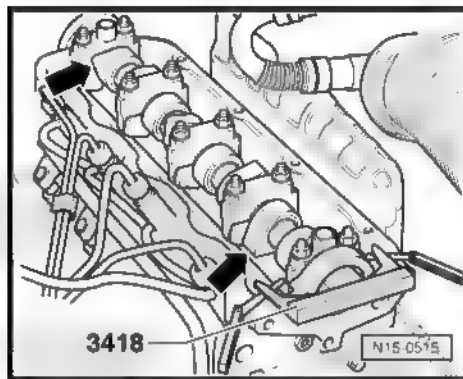


**i** Note

*Remove seal excess of covers 1 and 5 of the cylinder head. No seal shall be on the seal surface of the cylinder head/cylinder head cover*



- Lock the camshaft, as indicated, with the Adjustment ruler -3418 -.
- Calculate the adjustment ruler average as follows: Turn the locked camshaft, so that one camshaft bar end touches the cylinder head. On the other adjustment ruler end, measure the clearance with a gauge. Place the gauge with half of the clearance measure between the adjustment ruler and the cylinder head. Turn the camshaft until adjustment ruler touches the gauge. Insert another gauge with the same measure in the other end between the adjustment ruler and the cylinder head.



**Note**

*The camshaft can also be locked with the Camshaft bar - T10098 -.*

- Install the toothed belt of the camshaft ➔ [page 33](#) .
- Install the mechanical distribution upper cover, the cylinder head cover and the vacuum pump.



**Note**

*After installing the new hydraulic tappets, the engine shall not run for approx. 30 minutes. Hydraulic compensation elements shall seat (otherwise, the valves will hit the pistons).*

## 2.5 Hydraulic tappets - check

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden and/or plastic wedge



**Note**

- ◆ *Replace the hydraulic tappets completely (they can not be adjusted neither repaired).*
- ◆ *Irregular valve noises when starting the engine are normal.*

Prerequisites:

- Minimum engine oil temperature at 80 °C
- Start the engine and let it run at idle speed until the radiator blower starts operating one time.
- Increase rotation to 2500 rpm for 2 minutes.

If the hydraulic tappets continue making noise, locate the defective tappet as follows.

- Remove the cylinder head cover.
- Turn the crankshaft clockwise until the tappets starting cams, that are to be checked, face upwards.
- Determine clearance between cams and tappets
- If the clearance is more than 0.1 mm, replace the tappet. If clearance is less than 0.1 mm or any clearance is detected, proceed with the check as follows:

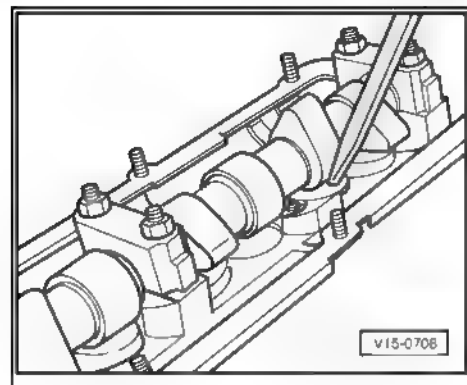


- Slightly compress the tappet downwards by using a wooden and/or plastic wedge. If it is possible to insert a blade gauge of 0.1 mm between camshaft and the impeller, replace the tappet



**Note**

*After installing the new hydraulic tappets, the engine shall not run for approx. 30 minutes. Hydraulic compensation elements shall seat (otherwise, the valves will hit the pistons).*





## 17 – Lubrication system

### 1 Lubrication system components - remove and install



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



#### Note

- ◆ *In case metal shavings and large amounts of small metal particles are detected in the engine oil while repairing an engine*
  - mainly caused by friction of the crankshaft and rod bearings
  - replace the oil filter and carefully clean the oil galleries.
- ◆ *The oil shall not exceed the Max. level, otherwise the catalyzer unit may be damaged!*

Check oil pressure ⇒ [page 62](#) .

Oil filling quantities

With oil filter 4.3 l

4) Current values:⇒ Data sheets for exhaust emission test

Engine oil specification

Use oils with high lubrication capacity according to specification  
-VW 505 00- or -VW 505 01- ⇒ Chemical Materials Manual .

Part I: assembly overview ⇒ [page 56](#)

Part II: disassembly of the oil filter support ⇒ [page 58](#)

Part I



1 - 15 Nm

2 - Seal flange

- ☐ With seal ring
- ☐ Remove and install  
⇒ [page 20](#)
- ☐ Do not lubricate nor grease the seal lip
- ☐ Prior to installation, remove oil residues from the crankshaft journal with a clean cloth
- ☐ Replace the crankshaft seal (pulley side)  
⇒ [page 17](#)

3 - Chain tensioner with sensor rail

- ☐ 15 Nm
- ☐ When installing, pre-tension the spring and hook it

4 - Gear

5 - Oil dipstick

- ☐ The oil level must not exceed the Max mark.
- ☐ Marks ⇒ [page 58](#)

6 - Funnel

- ☐ Remove in order to aspirate the oil

7 - Guide tube

8 - Oil ejector

- ☐ For piston refrigeration

9 - 25 Nm

- ☐ Install without seal

10 - Seal ring

- ☐ Replace

11 - Guide-bushing

12 - Oil sucking tube

- ☐ Clean the sieve in case it is dirty

13 - Acoustic muffler

14 - Oil sump

- ☐ Clean the seal surfaces prior to installation
- ☐ Remove and install ⇒ [page 59](#)

15 - Oil draining plug

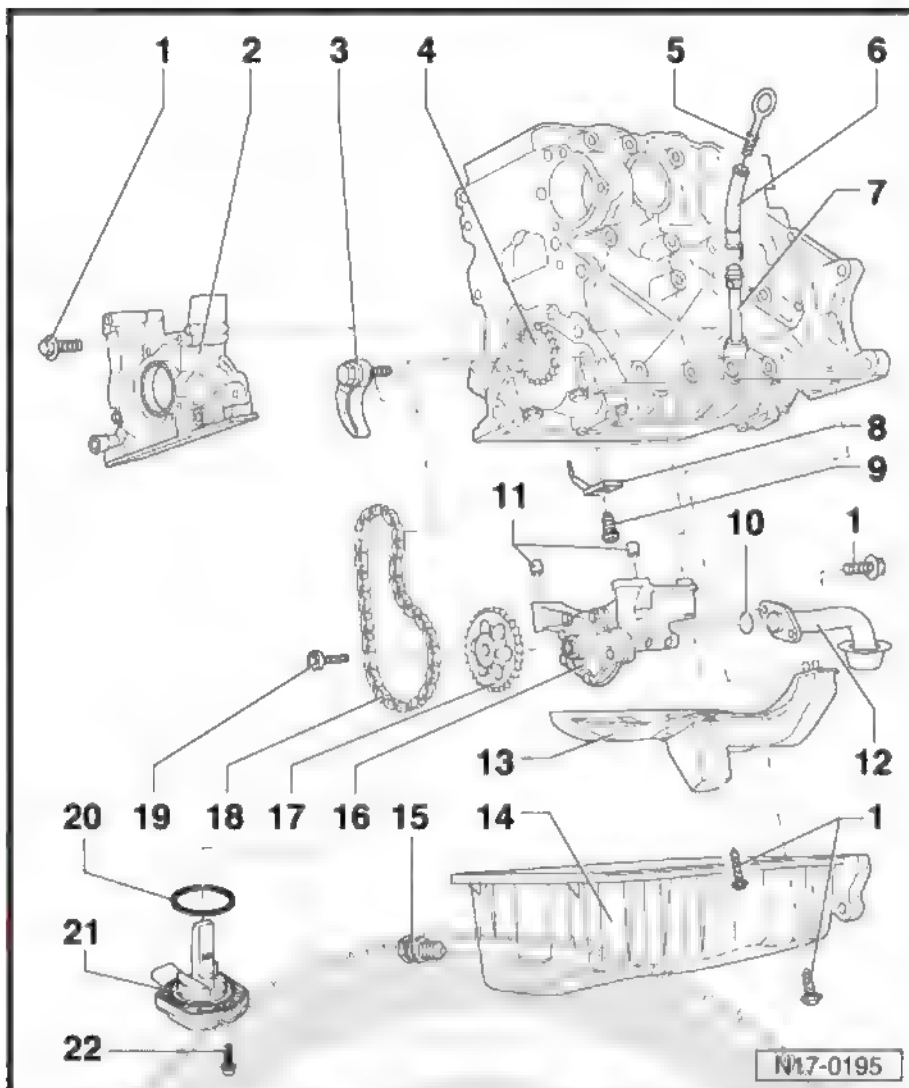
- ☐ 30 Nm
- ☐ In case the seal ring leaks, cut and replace the seal ring

16 - Oil pump

- ☐ With 12 bar over pressure valve
- ☐ ?Prior to installation, check if the two guide-bushings for centering the oil pump/engine block are installed

17 - Oil pump chain gear

- ☐ Watch the installation position





- ☐ Only fits in one position

18 - Chain

19 - 20 Nm + 90°

20 - Sealant

- ☐ Replace

21 - Oil level and oil temperature sender -G266-

22 - 10 Nm

#### Marks on the oil dipstick

1 - Max. mark

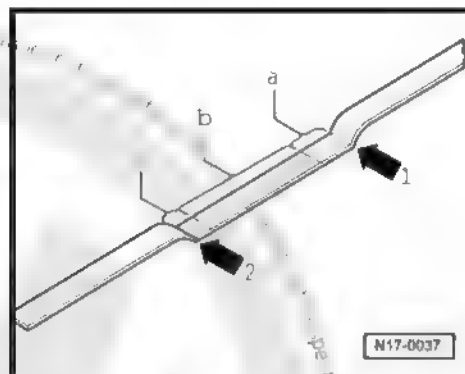
2 - Min. mark

nd - Area between the upper edge of the printed area and max. mark: do not refill with oil

b - Oil level in the marked area: Can be filled with oil

c - Area between the min. mark and the lower corner of the marked area: Refill with max. 0,5 l engine oil

#### Part II



1 - Oil filter support

2 - 15 Nm + 90°

- ☐ Replace
- ☐ First install the left upper screw and the right lower screw and then the two remaining ones, afterwards tighten the four screws crosswise

3 - Gasket

- ☐ Replace

4 - Sealant

- ☐ Replace

5 - Plug

- ☐ 25 Nm
- ☐ Do not loosen

6 - Cover

- ☐ 25 Nm
- ☐ Loosen and tighten with the Oil filter spanner Wrench -3417-

7 - Seal ring

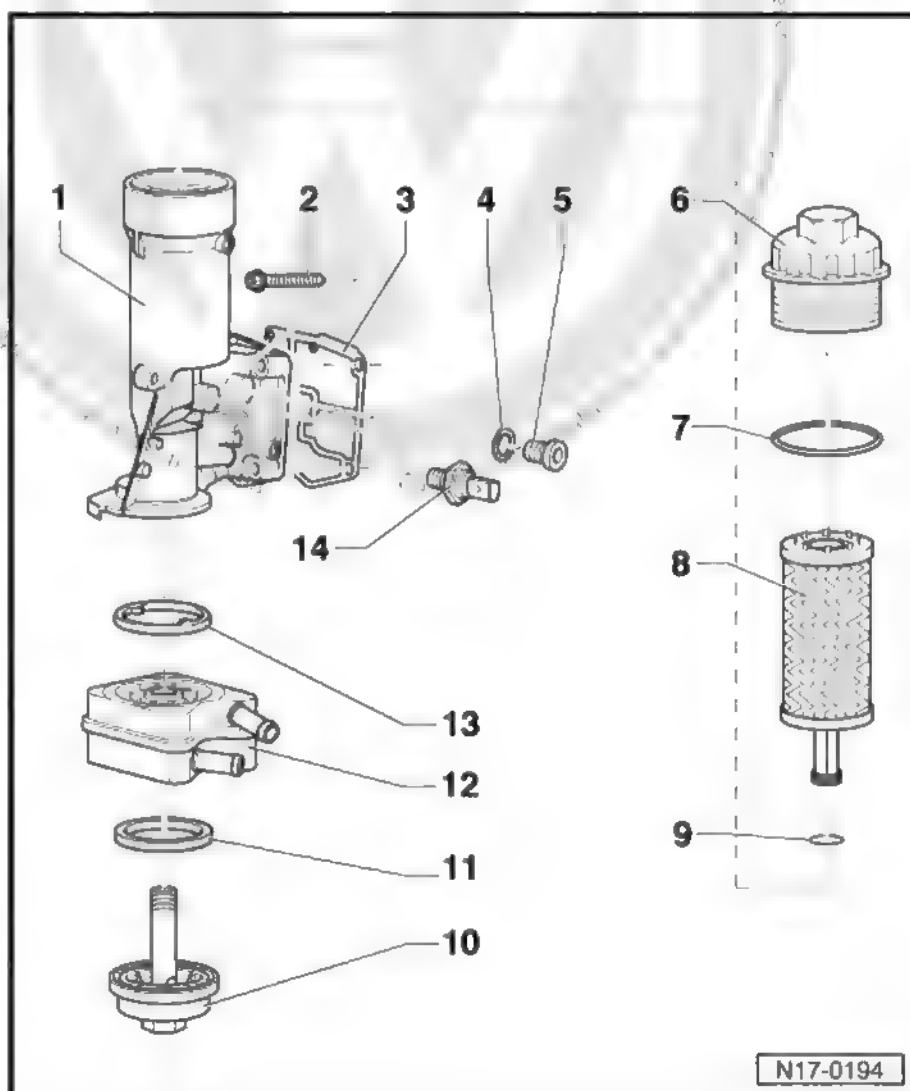
- ☐ Replace

8 - Oil filter element

- ☐ Observe installation position: Marking "TOP" on top

9 - Seal ring

- ☐ Replace





10 - Drain plug

- ☐ 25 Nm

11 - Gasket

- ☐ Replace

12 - Oil radiator

- ☐ Watch the mobility in relation to the surrounding components

13 - Gasket

- ☐ Replace

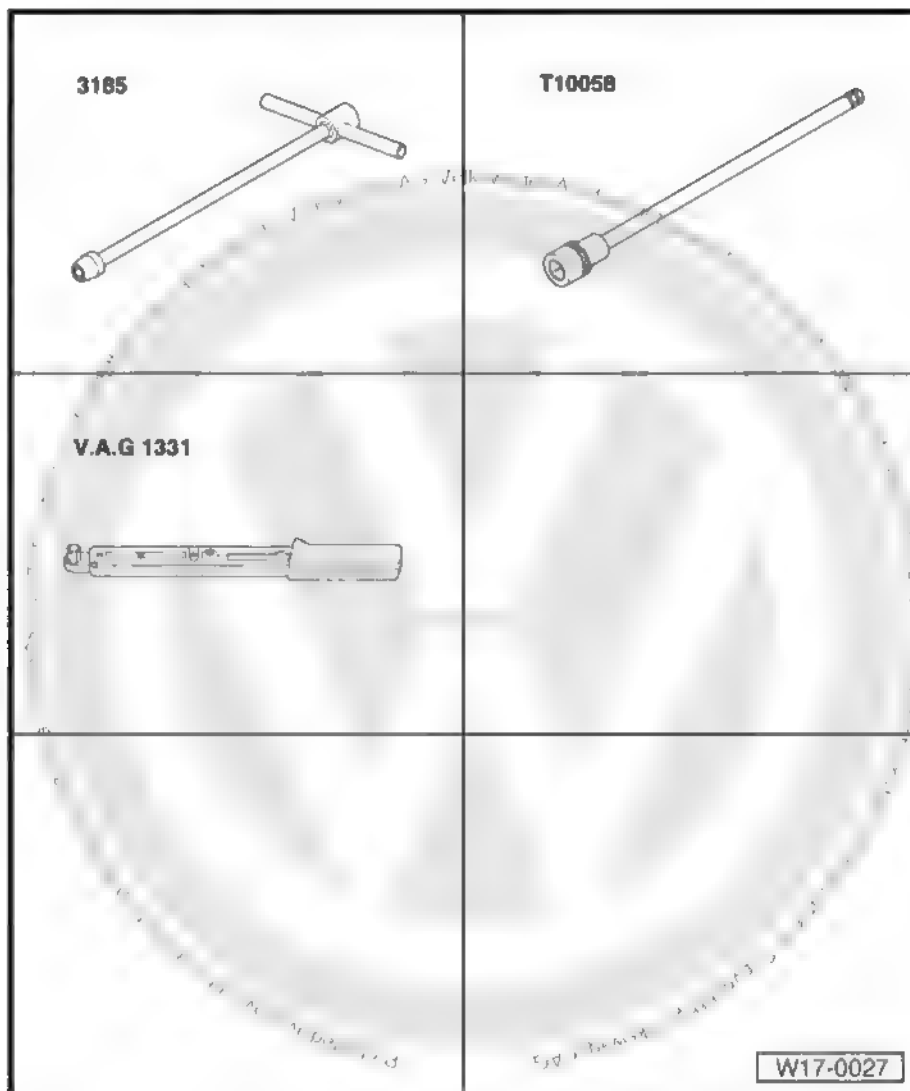
14 - Oil pressure switch -F1-

- ☐ 20 Nm
- ☐ 0.7 bar sensor: brown
- ☐ In case the seal ring leaks, cut and replace the seal ring
- ☐ Check ⇒ [page 62](#)

## 1.1 Oil sump - remove and install

### Special tools and workshop equipment required

- ◆ Extension socket wrench 10 mm -3185-
- ◆ Socket -T 10058-
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-



- ◆ Portable drill with plastic brush



- ◆ Flat spatula
- ◆ Safety goggles
- ◆ Silicone seal -D 176 404 A2-

### 1.1.1 Removal

- Remove lower engine compartment anti-rattler ⇒ Body - external mountings, Rep Gr. 50 ; Noise insulation - remove and install .
- Disconnect the Oil level and oil temperature sender -G266- .
- Drain the engine oil.



#### Note

*Respect the oil disposal regulations!*

- Release the oil sump.



#### Note

*Loosen the flywheel side screws with the Extension socket wrench 10 mm -3185- and Socket -T 10058- .*

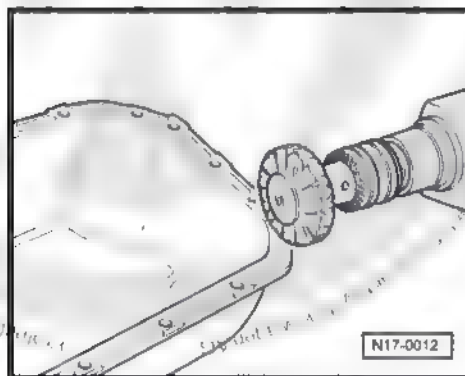
- Remove the oil sump. If necessary, loosen the oil sump by slightly hitting it with a rubber hammer.
- Eliminate seal residues from the engine block with a flat spatula.
- Eliminate seal residues from the oil sump with a plastic rotating brush installed on the drill.



#### WARNING

*Wear safety goggles!*

- Clean the seal surfaces. They must be free of oil and grease.



### 1.1.2 Installation



#### Note

- ◆ *Observe the seal expiration date.*
- ◆ *The oil sump shall be installed within 5 minutes after application of the silicone seal.*
- ◆ *Oil sump may be easily and safely installed with threaded screws M6 on two point of the flange on the engine block.*

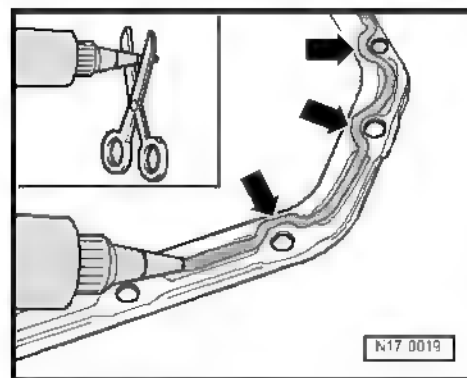


- Cut the tube injector at the front mark (Ø of the injector is approx. 3 mm).
- Apply silicone seal on the clean oil sump seal surface as shown in the illustration. Seal cord shall:
  - ◆ be 2...3 mm thick.
  - ◆ Pass inside screws hole area -arrows-



#### Note

*The seal shall not be applied in a thick layer because seal excess may enter the lubrication channels or the camshaft bearings and cause damage to the engine.*

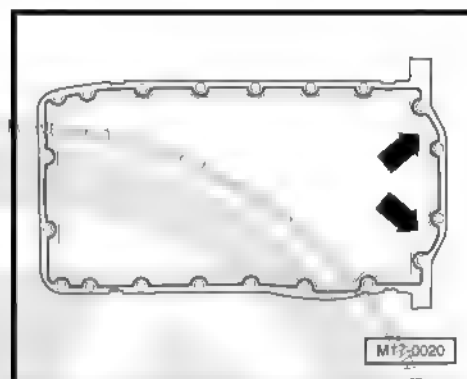


- Apply silicone seal on the clean oil sump surface as illustrated (the illustration shows the position of the seal cord on the engine block).
- Immediately install the oil sump and tighten all screws a little.



#### Note

*Tighten the flywheel side screws with the Extension socket wrench 10 mm -3185- and Socket -T 10058-.*



- Tighten flange fastening screws crosswise to a torque of 15 Nm.
- Tighten oil sump/gearbox screws with 45 Nm.



#### Note

*After installation of the oil sump, the seal shall dry for approx. 30 minutes. Only after this period of time can the engine be filled with engine oil.*

## 1.2 Oil pump - remove and install

### 1.2.1 Removal

- Remove lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50; Noise insulation - remove and install.
- Remove the oil sump ⇒ [page 59](#).
- Remove the acoustic muffler ⇒ [Item 13 \(page 57\)](#).
- Relieve the chain tensioner and remove the chain.
- Loosen the screw ⇒ [Item 19 \(page 58\)](#) and remove the oil pump chain gear ⇒ [Item 17 \(page 57\)](#).
- Loosen the screws and remove the oil pump
- Remove the oil suction tube from the oil pump

### 1.2.2 Installation

Installation is carried out in the reverse order of removal, considering the following:

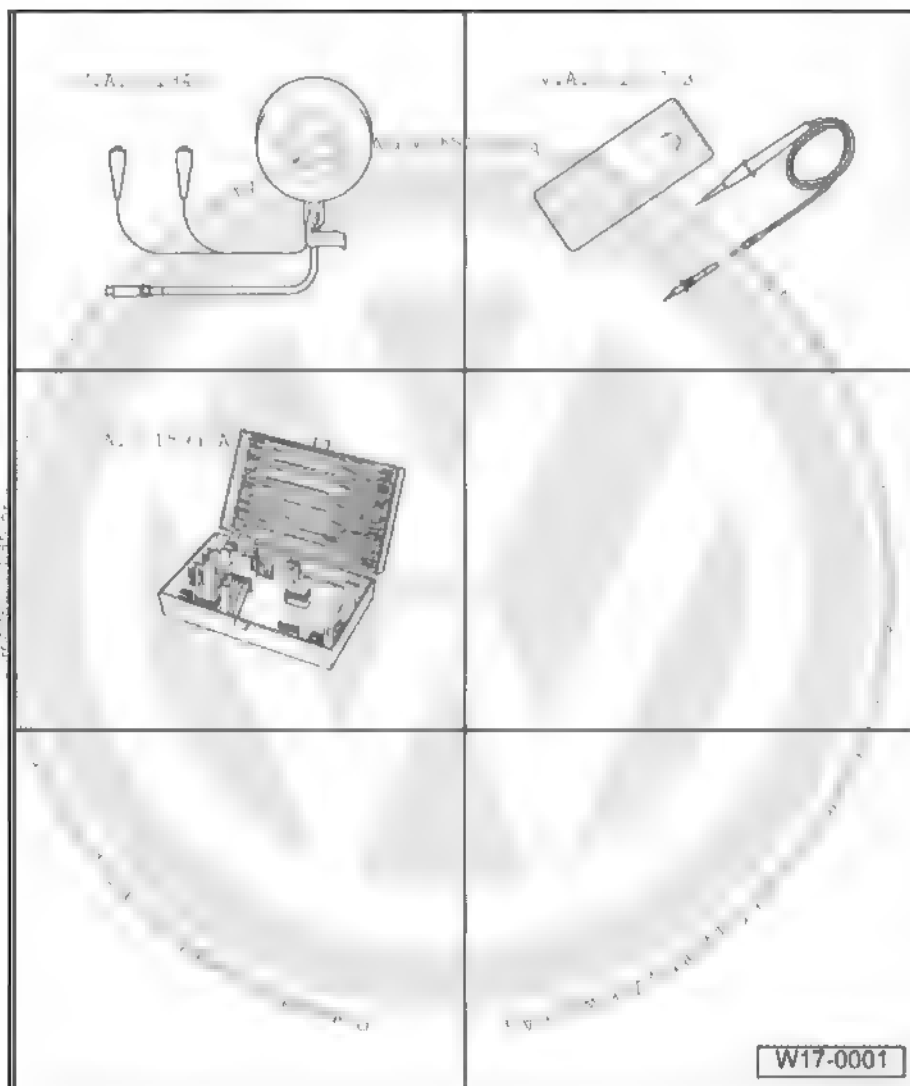


- Tighten the fixing screws of the oil suction tube and oil pump with 15 Nm.
- Tighten the fixing screws of the chain gear with 20 Nm + 90°.
- Watch the installation position of the chain gear  
➔ [Item 17 \(page 57\)](#) .

### 1.3 Oil pressure switch -F1- - check

Special tools and workshop equipment required

- ◆ Oil pressure tester -VAG 1342-
- ◆ Test tip -EQ 7300 (VWB) - or - VAG 1527B-
- ◆ Measurement auxiliary cable set -VAG 1594C-



W17-0001

#### Function:

The Oil pressure switch -F1- will open without pressure or with insufficient operating pressure.

After switching on the ignition, with the engine at standstill, the Oil pressure control light -K3- on the instrument panel will light for approx. 3 seconds and then turn off again. Check shall be interrupted when the engine is running.

A Oil pressure control light -K3- The Oil pressure control lamp will also turn on when the engine speed is higher than 1500 rpm, the oil switch is open or when the speed exceeds 5000 rpm, in this case even if the switch is closed.

#### Checking conditions:

- Engine oil level in order, check ➔ [page 58](#)



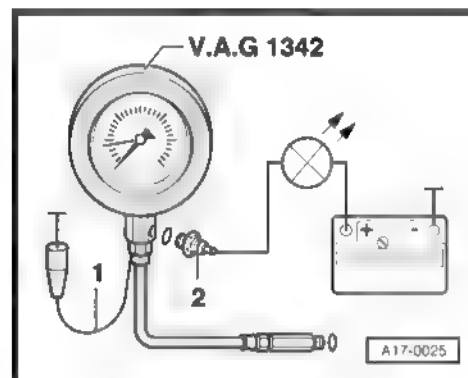
- Engine oil temperature shall be at minimum 80 °C (radiator blower of the coolant shall have run once)



#### Note

*Operation test and repair of the oil pressure optical and acoustic meter ⇒ Current flow diagrams, Electrical fault finding and Fitting locations*

- Remove the Oil pressure switch -F1- and install it on the test equipment.
- Install the test equipment in place of the oil pressure switch on the oil filter support.
- Connect the brown cable of the test equipment to the ground (-).
- Connect the Test tip -EQ 7300 (VWB) - or - VAG 1527B- with Measurement auxiliary cable set -VAG 1594C- on the positive battery terminal (+) and Oil pressure switch -F1- . Diode lamp shall turn on.



If LED does not turn on:

- Replace the Oil pressure switch -F1- .

If the diode lamp turns on:

- Start engine and slowly increase the speed. With 0.55...0.85 bar pressure, the diode lamp shall turn off, otherwise, replace the oil pressure switch.
- Continue increasing the speed. With 2000 rpm and an oil temperature of 80 °C, the oil pressure shall be at least 2.0 bar.

If nominal values are not reached:

- Check for mechanical damages and eliminate them.
- Replace the oil filter support with the Oil pressure switch -F1- or the oil pump.

At higher rotations, the oil pressure shall not exceed 7.0 bar.

If the rotation exceeds 7.0 bar:

- Check oil galleries.
- Replace the oil filter support with the Oil pressure switch -F1- .



## 19 – Cooling system

### 1 Cooling system components - remove and install



#### WARNING

*For installation work, especially in the engine compartment, due to reduced existing space, consider the following:*

- ◆ *All hoses (e.g. fuel, hydraulic, activated charcoal filter system, coolant and refrigerant gas, brake fluid, vacuum) and electric cables must be arranged in a way to return to their original positions.*
- ◆ *Ensure easy access to all mobile parts or that may be hot.*



#### Note

- ◆ *The cooling system is under pressure when the engine is hot. For this reason it is necessary to reduce pressure prior to any repairs.*
- ◆ *Hose unions are fixed by spring clamps. In case of repairs, only use spring clamps.*
- ◆ *To install the spring clamps, it is recommended you use Standard type clamp pliers - VW 5162 (VWB) - or - VAS 5024A.*
- ◆ *Install coolant hoses without any tension, so that they do not get in contact with other components (observe marks on the coolant connection on the hose).*

Check the cooling system for leaks again with Cooling system tester VAG 1274- and Adapter for VAG 1274 -VAG 1274/8- .

Cooling system components on the body side ⇒ [page 64](#) .

Cooling system components on the engine side ⇒ [page 66](#) .

Connection diagram of the coolant hoses ⇒ [page 67](#) .

Drain and fill with coolant ⇒ [page 68](#) .

Indications for coolant preparation ⇒ [page 68](#) .

#### 1.1 Cooling system components on the body side



# 1 - Radiator

- ☐ Remove and install  
→ [page 71](#)
- ☐ After replacing, change all coolant

## 2 - Seal ring

- ☐ Replace

## 3 - Upper coolant hose

- ☐ Fastened to radiator by a clamp
- ☐ Ensure proper fixing
- ☐ Connection diagram of the coolant hoses  
⇒ [page 67](#)

## 4 - Air deflector

## 5 - 5 Nm

## 6 - Reservoir lid

- ☐ Check the cooling system for leaks again with Cooling system tester - VAG 1274- and with Adapter for VAG 1274 - VAG 1274/8-
- ☐ Test pressure: 1.4 ... 1.6 bar

## 7 - 10 Nm

## 8 - Coolant container

- ☐ Check the cooling system for leaks again with Cooling system tester - VAG 1274- and with Adapter for VAG 1274 - VAG 1274/8-

## 9 - Blower housing

## 10 - 5 Nm

## 11 - Radiator fan -V7-

## 12 - Lower coolant hose

- ☐ Fastened to radiator through retaining fastener
- ☐ Ensure proper fixing
- ☐ Connection diagram of the coolant hoses ⇒ [page 67](#)

## 13 - Support

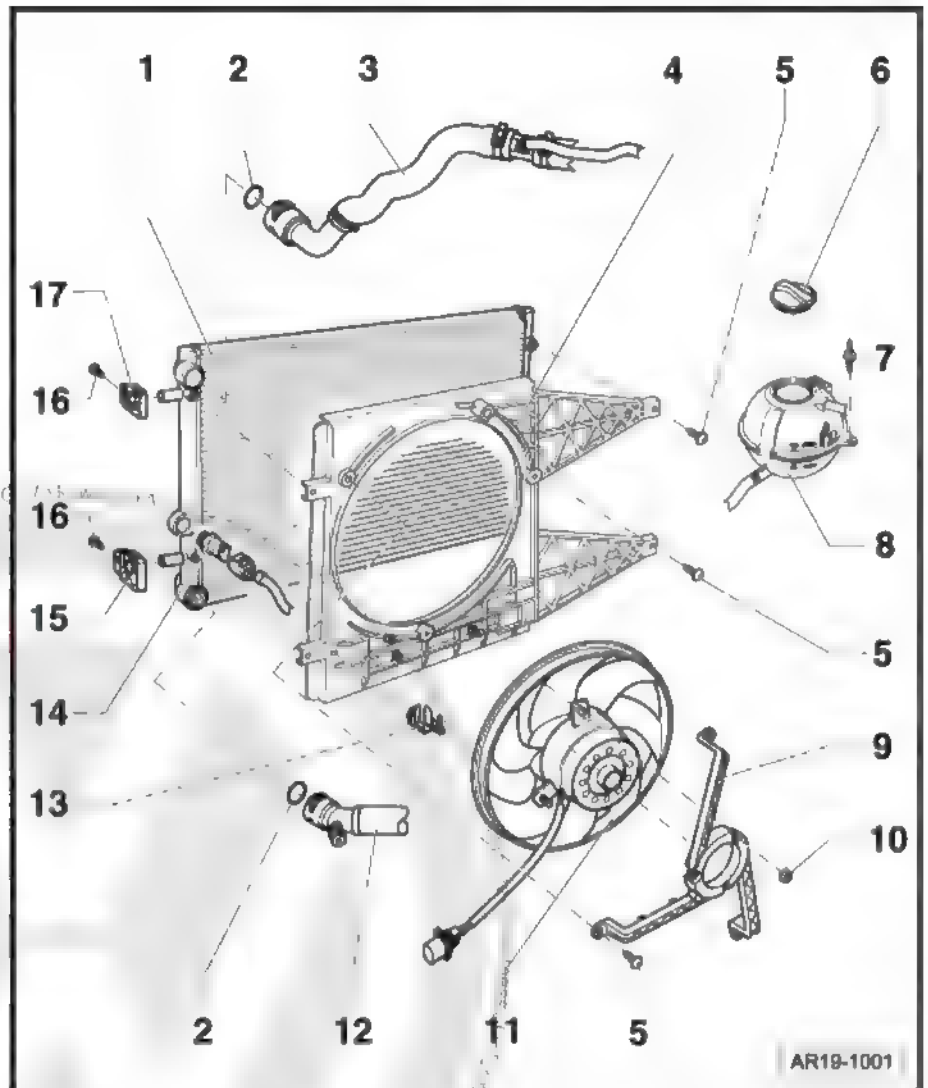
- ☐ For blower connector

## 14 - Radiator fan thermal switch -F18-

- ☐ 35 Nm
- ☐ From electrical blower
- ☐ Connection temperatures: Level 1 turns on: 92. ... 97 °C turns off 84...91 °C Level 2 turns on: 99. ... 105 °C turns off. 91...98 °C

## 15 - Support

- ☐ Of radiator
- ☐ Observe the installation position
- ☐ Observe the different models





16 - 5 Nm

17 - Support

- ☐ Of radiator
- ☐ Observe the installation position
- ☐ Observe the different models

## 1.2 Cooling system components on the engine side

1 - Cooling system upper tube

- ☐ Fixed to the intake manifold

2 - 10 Nm

3 - Connection nozzle

- ☐ To heat exchanger

4 - Connection nozzle

- ☐ On the cylinder head

5 - Distribution part

6 - For radiator upper part

- ☐ Connection diagram of the coolant hoses  
⇒ [page 67](#)

7 - 15 Nm

8 - Coolant temperature sender -G62-

- ☐ With Coolant temperature sender -G2-
- ☐ For Diesel direct injection system control unit -J248-
- ☐ If necessary, depressurize system before removal

9 - Clip

- ☐ Ensure proper fixing

10 - Seal ring

- ☐ Replace

11 - Sealant

- ☐ Replace
- ☐ Ensure proper fixing

12 - Coolant container

- ☐ Connection diagram of the coolant hoses ⇒ [page 67](#)

13 - For coolant container

- ☐ Connection diagram of the coolant hoses ⇒ [page 67](#)

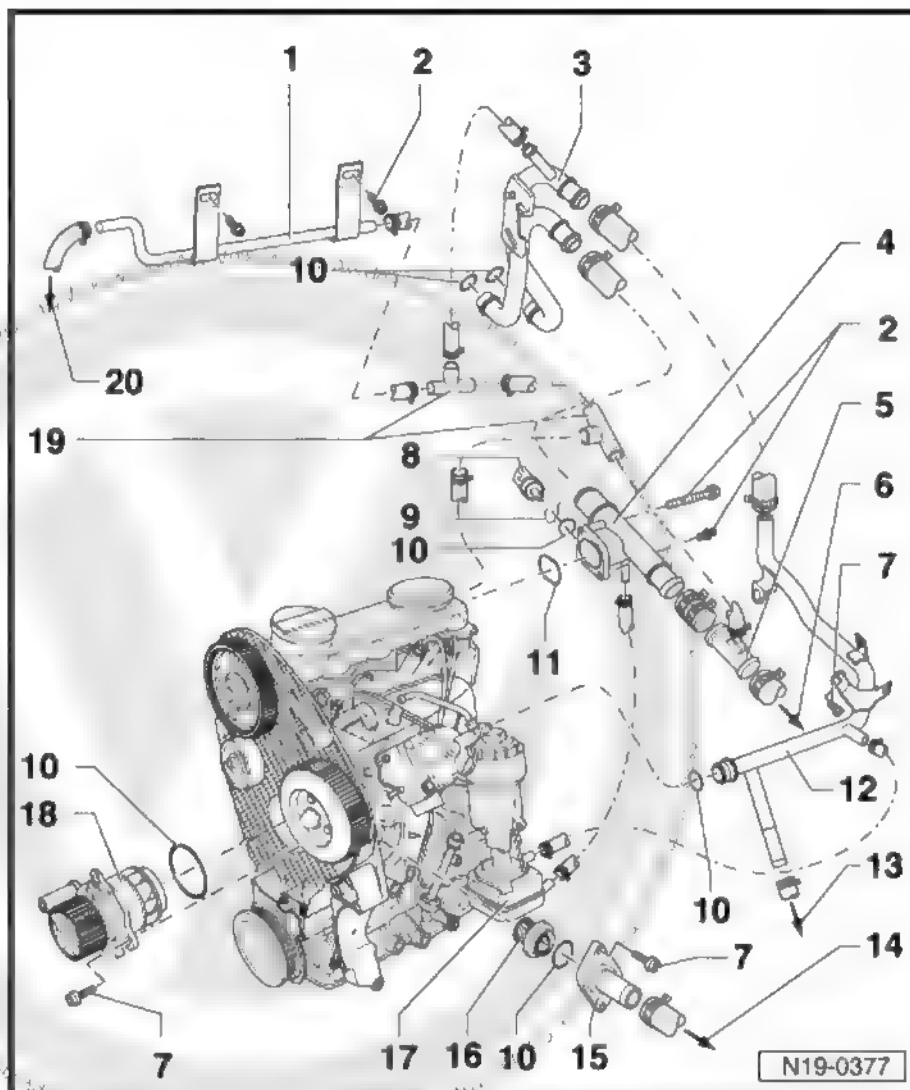
14 - For radiator lower part

- ☐ Connection diagram of the coolant hoses ⇒ [page 67](#)

15 - Thermostatic valve flange

16 - Thermostatic valve

- ☐ Check the operation: Heat the valve in water. Thermal element pin must move outwards





- ☐ Opening start (approx. 86 °C)
- ☐ Opening stroke at least 7 mm

#### 17 - Oil radiator

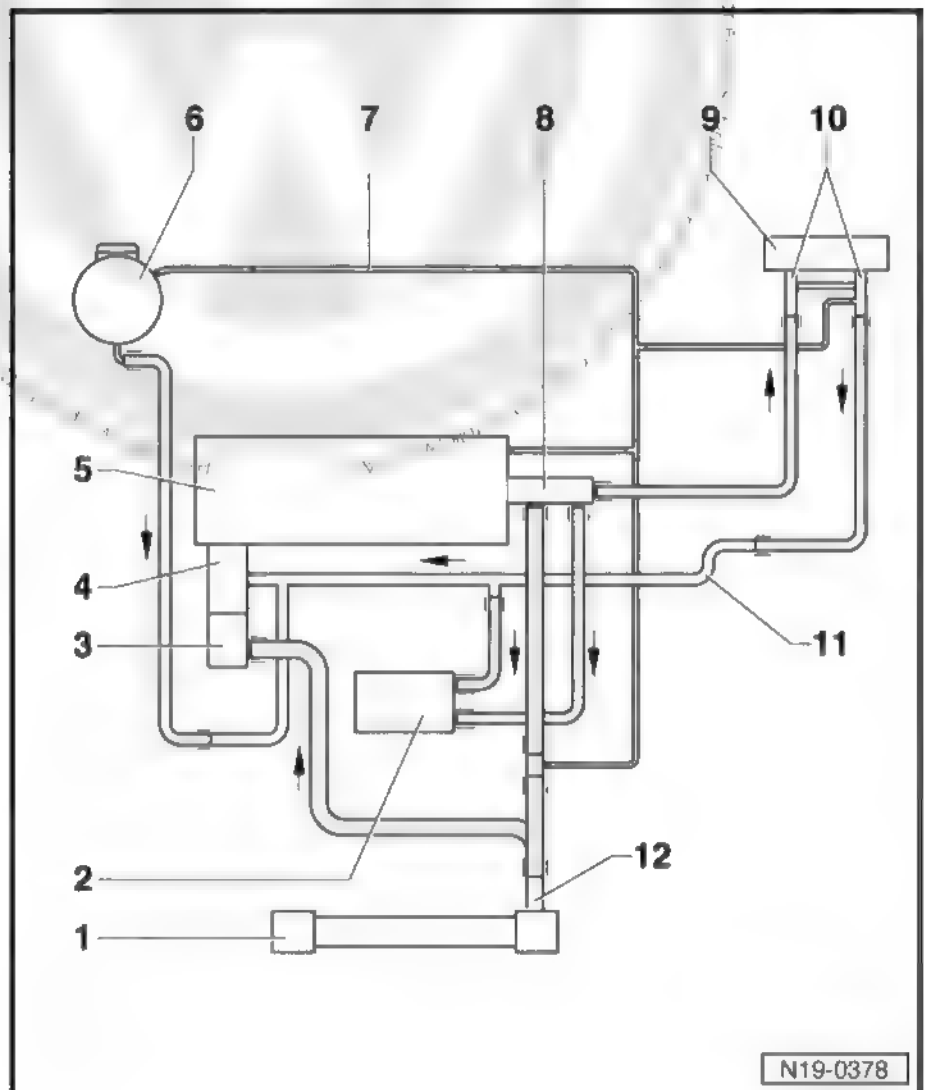
#### 18 - Water pump

- ☐ Check for smooth operation
- ☐ In case of faults and leakage, replace the complete pump along with the seal
- ☐ Remove and install [⇒ page 72](#)

#### 19 - Distribution part

### 1.3 Connection diagram of the coolant hoses

- 1 - Radiator
- 2 - Oil radiator
- 3 - Coolant thermostatic valve
- 4 - Water pump
- 5 - Cylinder head/engine block
- 6 - Coolant container
- 7 - Cooling system upper tube
- 8 - Connection nozzle
- ☐ On the cylinder head
- 9 - Heat exchanger for heating
- 10 - Connection nozzle
- ☐ To heat exchanger
- 11 - Coolant container
- 12 - Rapid coupling

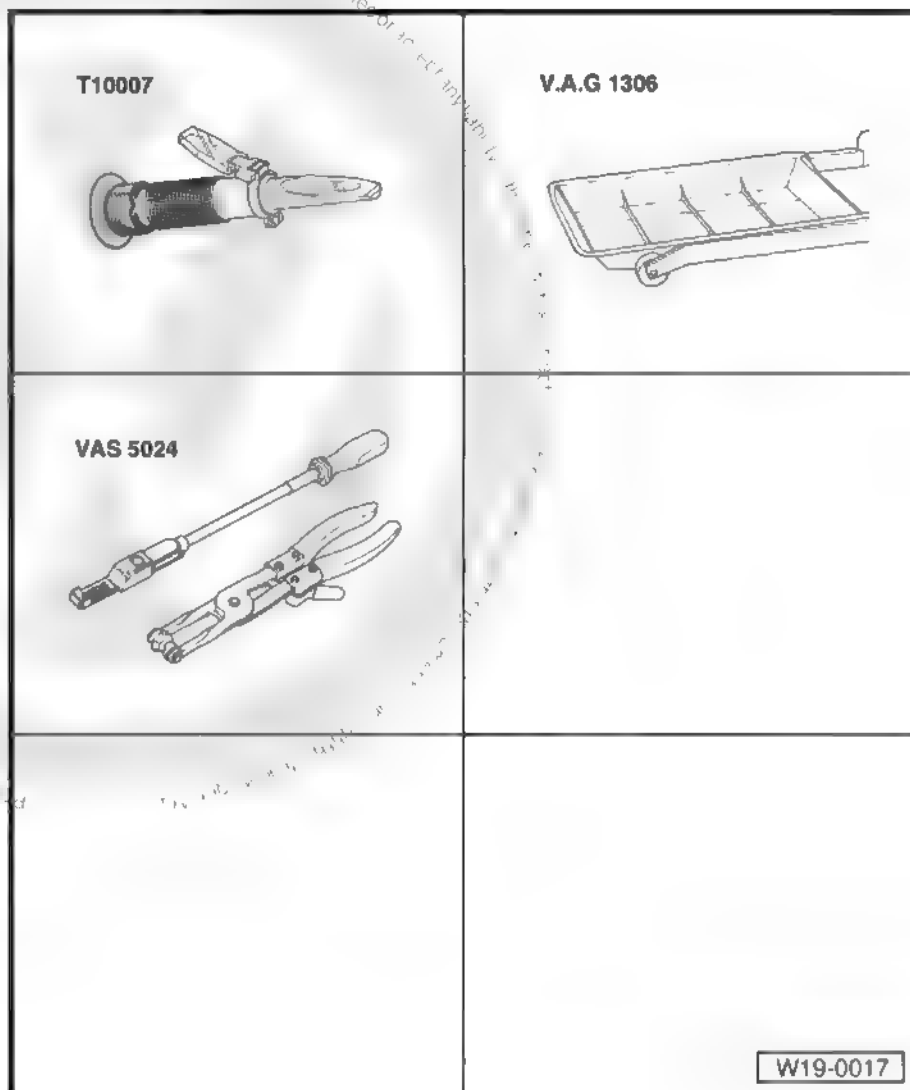




## 1.4 Coolant - drain and fill

### Special tools and workshop equipment required

- ◆ Refractometer for coolant analysis -EQ 7093 (VWB) - or T 10007-
- ◆ Drip tray -VAG 1306-
- ◆ Standard type clamp pliers -VAS 5024A-



- ◆ Cooling system supply unit -VAS 6096-

### 1.4.1 Drain



#### WARNING

*Hot steam may escape while opening the coolant container, thus put a cloth over the cover to open it carefully.*

- Open the coolant container cover
- Remove the lower engine compartment noise insulator ⇒ Body - external mountings, Rep Gr. 50 , Noise insulation - remove and install



- Loosen the drain plug -arrow- for the radiator coolant.

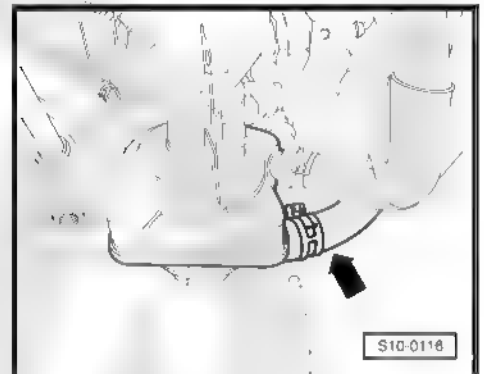


- To drain the coolant, remove also the cooling hose -arrow- at the oil radiator.



**Note**

*Observe disposal regulations for coolant!*





## 1.4.2 Fill



### Note

- ◆ If possible, use the Additive -G12- identified by its purple color according to norm TL VW 774 F.
- ◆ Under no circumstance mix Additive -G12- purple with other antifreeze additives.
- ◆ If the liquid in the container is brown, this means Additive -G12- has mixed with another antifreeze additive. In this case, replace all of the coolant liquid.
- ◆ The Additive -G12- and antifreeze additives with the indication "in compliance with TL VW 774 F" avoid deterioration caused by corrosion, freezing or lime sedimentation, increasing the coolant boiling temperature even more. For these reasons, the cooling system must always contain prescribed mix of anti-freeze and anti-corrosion products.
- ◆ Especially in tropical climate countries, the anti-freeze offers great help, due to its high boiling point, to ensure safety when the engine is submitted to intense operation.
- ◆ Anti-freeze protection shall be ensured to approximately -25 ° C (and approximately to -35 ° C in arctic climate countries).
- ◆ Coolant concentration shall not be reduced by adding water in hot seasons or hot countries. Anti-freeze additive percentage shall be of a minimum 40 %.
- ◆ If for weather reasons it is necessary to have greater anti-freeze protection, the percentage of Additive -G12- can be increased, but only to 60% (antifreeze protection to up to -40° C). The higher the proportion the lower is the cooling capacity and anti-freeze protection.
- ◆ To determine antifreeze protection density, it is recommendable to use Refractometer for coolant analysis -EQ 7093 (VWB) - or - T 10007-.
- ◆ Do not reuse used coolant in case the radiator, heat exchanger, head or head gasket have to be replaced.

Recommended mixture ratios:

Anti-freeze protection until	Anti-freeze proportion	-G12- <sup>5)</sup>	Water <sup>6)</sup>
-25 °C	40 %	2.0 l	3.0 l
-35 °C	50 %	2.5 l	2.5 l

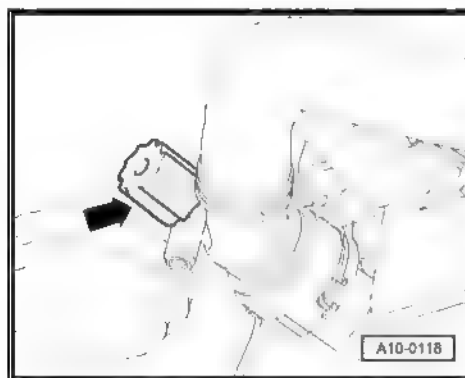
5) The quantity of coolant may vary according to each vehicle equipment.

- Close the drain plug -arrow- Screw drain plug into radiator and secure coolant hose on oil cooler connection.
- Install lower engine compartment anti-rattler ⇒ Body - external mountings; Rep Gr. 50 ; Noise insulation - remove and install .

With Cooling system supply unit -VAS 6096- :

- Fill the cooling system's circuit with Cooling system supply unit -VAS 6096- ⇒ Usage instructions for Cooling system supply unit -VAS 6096- .

Without Cooling system supply unit -VAS 6096- :





- Refill with coolant up to the max. mark on the coolant container

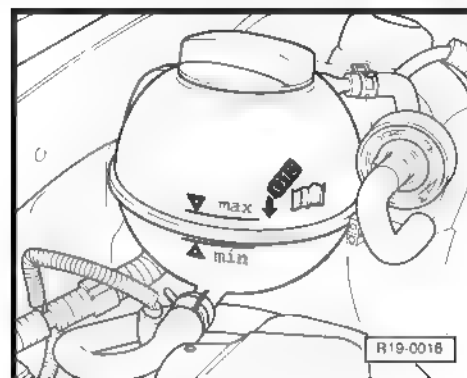
Continuation with and without Cooling system supply unit -VAS 6096- :

- Close the coolant container, switch the heating and air conditioning system off, start the engine and maintain the engine speed at 2,000 rpm for approx. 3 minutes
- Let the engine run until the blower turns on.



#### WARNING

*Hot steam may escape while opening the coolant container, thus put a cloth over the cover to open it carefully.*

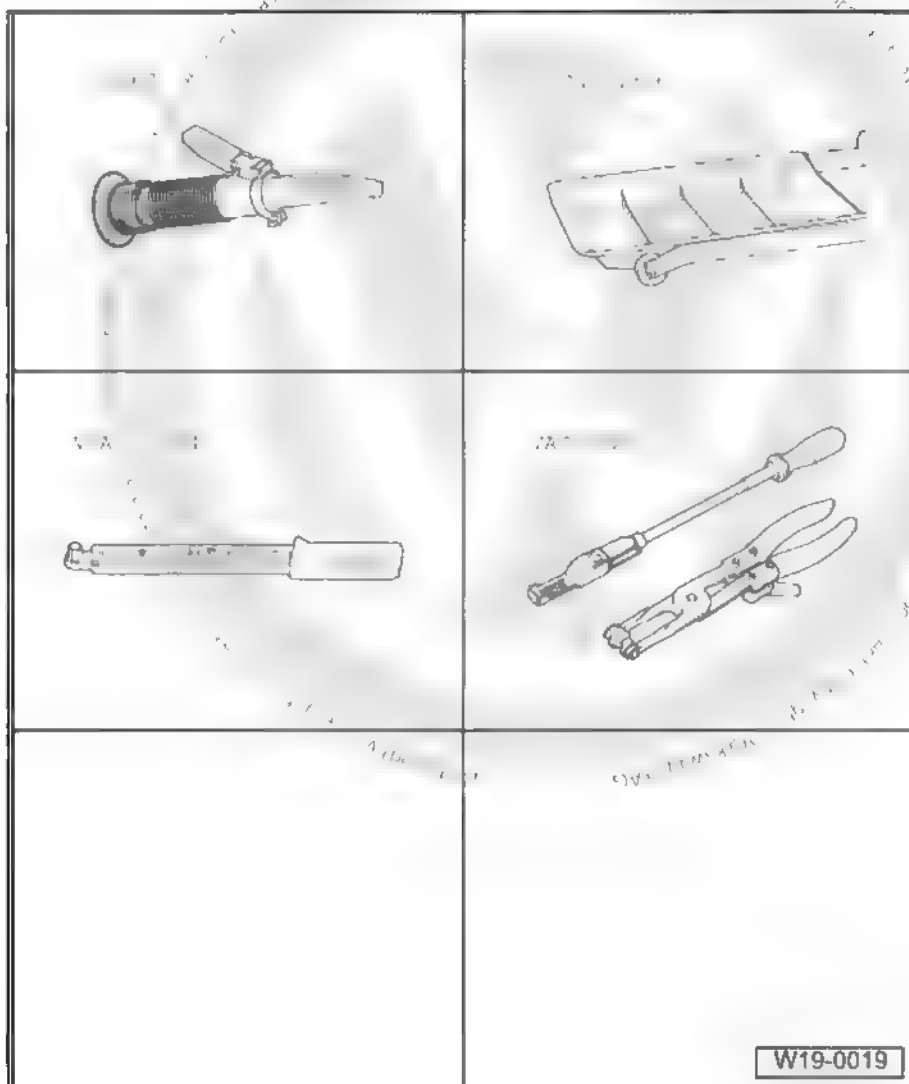


- Check the refrigerant level and refill, if necessary. When the engine is hot, the coolant level shall be on the max. mark and when the engine is cold, the coolant level shall be between the "max." and "min." marks.

## 1.5 Radiator - remove and install

### Special tools and workshop equipment required

- ◆ Refractometer for coolant analysis -EQ 7093 (VWB) - or - T 10007-
- ◆ Drip tray -VAG 1306-
- ◆ Torque wrench - 5 to 50 Nm (socket 1/2") -VAG 1331-
- ◆ Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A-





### 1.5.1 Removal

- Remove bumper cover ➔ Body - external mountings; Rep. Gr. 63 ; Bumper - remove and install .
- Removing the front panel ➔ Body - external mountings; Rep. Gr. 50 ; Body - Front part .
- Drain cooling fluid ➔ [page 68](#) .
- Release the radiator coolant hoses.
- Remove the radiator blower connector.
- Remove the radiator fixing screws and remove the radiator with the blower.
- Follow additional assembly instructions ➔ [page 72](#) .

### 1.5.2 Installation

Installation is carried out in the reverse order of removal, considering the following:

- Fill cooling fluid ➔ [page 68](#) .
- Remove front panel ➔ Body - external mountings; Rep. Gr. 50 ; Body - Front part .
- Install bumper cover ➔ Body - external mountings; Rep. Gr. 63 ; Bumper - remove and install .

### 1.5.3 Additional installation indications



#### WARNING

*Do not open the air conditioning refrigerant gas circuit.*



#### Note

*In order to avoid damages to the condenser and cooling gas tubes/hoses, ensure they are not twisted, folded or excessively stretched.*

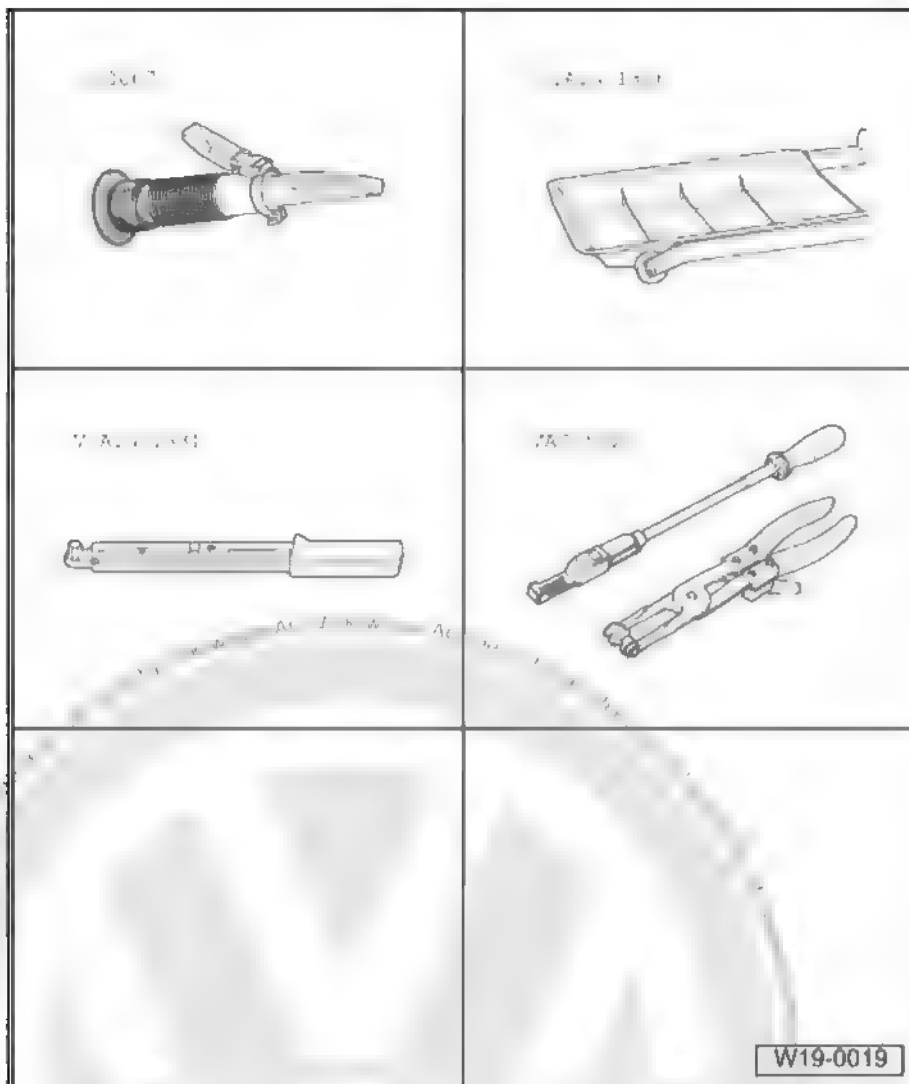
- Loosen the retaining clamps) of refrigerant gas hoses.
- Loosen the radiator condenser and support it.

### 1.6 Water pump - remove and install



#### Special tools and workshop equipment required

- ◆ Refractometer for coolant analysis -EQ 7093 (VWB) - or - T 10007-
- ◆ Drip tray -VAG 1306-
- ◆ Torque wrench - 5 to 50 Nm (socket 1/2") -VAG 1331-
- ◆ Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A-



W19-0019

### 1.6.1 Removal

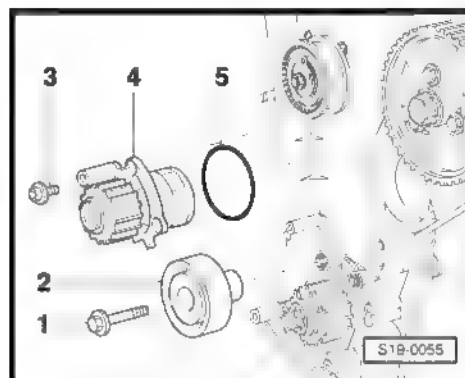


#### Note

- ◆ *Always replace seal rings and gaskets.*
- ◆ *The lower cover of the mechanical distribution may be kept installed.*
- ◆ *The toothed belt remains placed on crankshaft gear.*
- ◆ *Prior to removing the water pump, cover the toothed belt with a cloth in order to protect it against the coolant.*
- Remove lower engine compartment anti-rattler ⇒ Body - external mountings; Rep. Gr. 50; Noise insulation - remove and install .
- Drain cooling fluid → [page 68](#)
- Remove Poly-V belt → [page 14](#) .
- Remove the upper part and the intermediate part of the mechanical distribution cover → [page 11](#) .
- Remove the toothed belt from the camshaft gear → [page 33](#) .



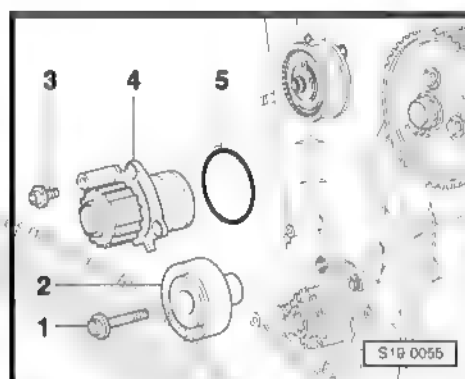
- Remove fixing screws -1- and remove the deflection pulley -2-.
- Remove the attaching screws -3- and remove the water pump -4-.



## 1.6.2 Installation

Installation is carried out in the reverse order of removal, considering the following:

- Dampen the sealing ring -5- with coolant.
- Place coolant pump on engine block and tighten screws to 15 Nm.
- Replace the fastening screw -1- for the deflection pulley -2- and install the deflection pulley with a torque of 40 Nm + 90°.
- Install and adjust the toothed belt ⇒ [page 32](#).
- Install Poly V belt ⇒ [page 14](#).
- Fill cooling fluid ⇒ [page 68](#).



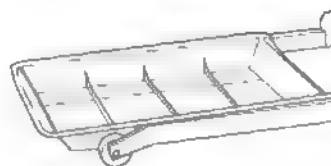
## 1.7 Thermostatic valve - remove and install



#### Special tools and workshop equipment required

- ◆ Drip tray -VAG 1306-
- ◆ Torque wrench - 5 to 50 Nm (socket 1/2") -VAG 1331-
- ◆ Hose clamping pliers -VAG 1921-
- ◆ Refractometer for coolant analysis -EQ 7093 (VWB) - or - T 10007-

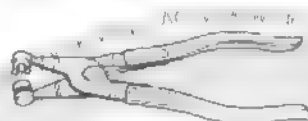
**V.A.G 1306**



**V.A.G 1331**



**V.A.G 1921**



W19-0001

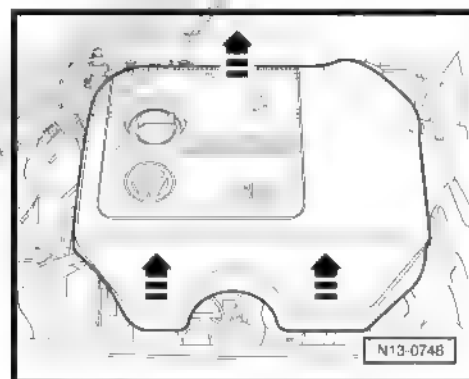
### 1.7.1 Removal

- Remove the engine cover in the direction of the arrows.
- Drain cooling fluid [⇒ page 68](#).



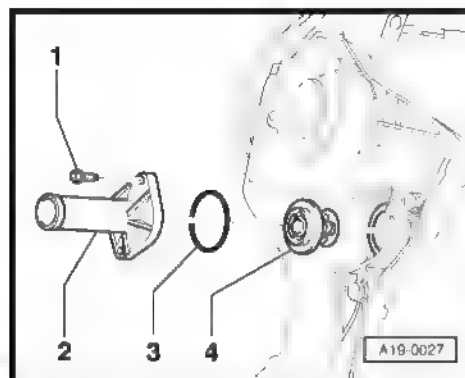
**Note**

*Always replace seal rings and gaskets.*





- Remove the hose from the connection flange -2-.
- Remove the attaching screws -1- and remove connection flange -2- with the thermostat valve -4-.
- To remove the thermostat valve -4- from the connection flange-2-, turn it to the left  $\frac{1}{4}$  of turn ( $90^\circ$ ).



### 1.7.2 Installation

Installation is carried out in the reverse order of removal, considering the following:

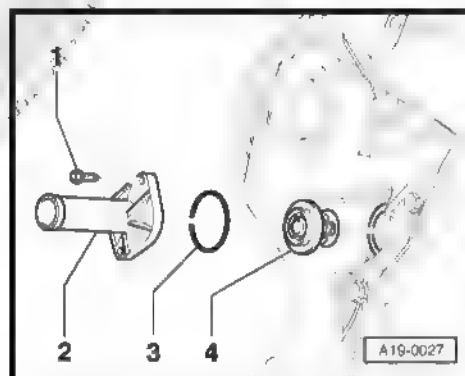
- Dampen the sealing ring -3- new coolant.
- Install the thermostat valve -4- on the connection flange -2- turning it to the left  $\frac{1}{4}$  of turn ( $90^\circ$ ).



#### Note

*The thermostatic valve braces shall be in an almost vertical position.*

- Install connection flange -2- with the thermostat valve -4- in the engine block.
- Tighten the fastening screws -1- with 15 Nm.
- Fill cooling fluid ⇒ [page 68](#) .





## 20 – Fuel supply system

### 1 Fuel supply system components - remove and install



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*



#### Note

- ◆ *Hose connections are fixed with either spring and quick coupling clamps (pop top), for the latter, although, it is necessary to replace the lock whenever it is disconnected.*
- ◆ *Only use spring clamps to fix the fuel hoses on the engine; clamp or screws are not allowed.*
- ◆ *To install the spring clamps, it is recommended you use Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A-.*

Follow the safety measures [⇒ page 81](#).

Respect cleaning rules [⇒ page 81](#).

Remove and install the fuel tank [⇒ page 82](#).

Remove and install the fuel tank components, accessories, and fuel filter [⇒ page 77](#).

Repair the fuel filter [⇒ page 80](#).

Check the engine power's electronic adjustment (electronic throttle) [⇒ page 86](#).

#### 1.1 Fuel tank with accessories - remove and install



1 - Reservoir lid

2 - Fixing screw

3 - Fuel tank cover

- ☐ With rubber cauls
- ☐ Remove and install Rep. Gr. 55

4 - Gravity valve

- ☐ To remove it, the left rear wheel house cover must be removed first
- ☐ Check the operation. Perpendicular valve: Open. Valve tilted 45°: Closed

5 - Ground connection

- ☐ Ensure proper fixing

6 - 10 Nm

7 - Ventilation hose

- ☐ Fixed on the top of the fuel tank

8 - 25 Nm

9 - Fuel tank

- ☐ Remove using ? Engine-/gearbox jack -EQ 7081 (VWB) - or - VAG 1383A-
- ☐ Remove and install ⇒ [page 82](#)

10 - Tension belt

11 - Fuel pre supply pump

- ☐ Remove and install ⇒ [page 84](#)
- ☐ Clean the filter in case it is dirty
- ☐ Observe the installation position of the flange in the fuel tank ⇒ [page 79](#)

12 - Sealant

- ☐ Replace when damaged
- ☐ For installation, dampen with fuel

13 - Fixing nut of the fuel pump

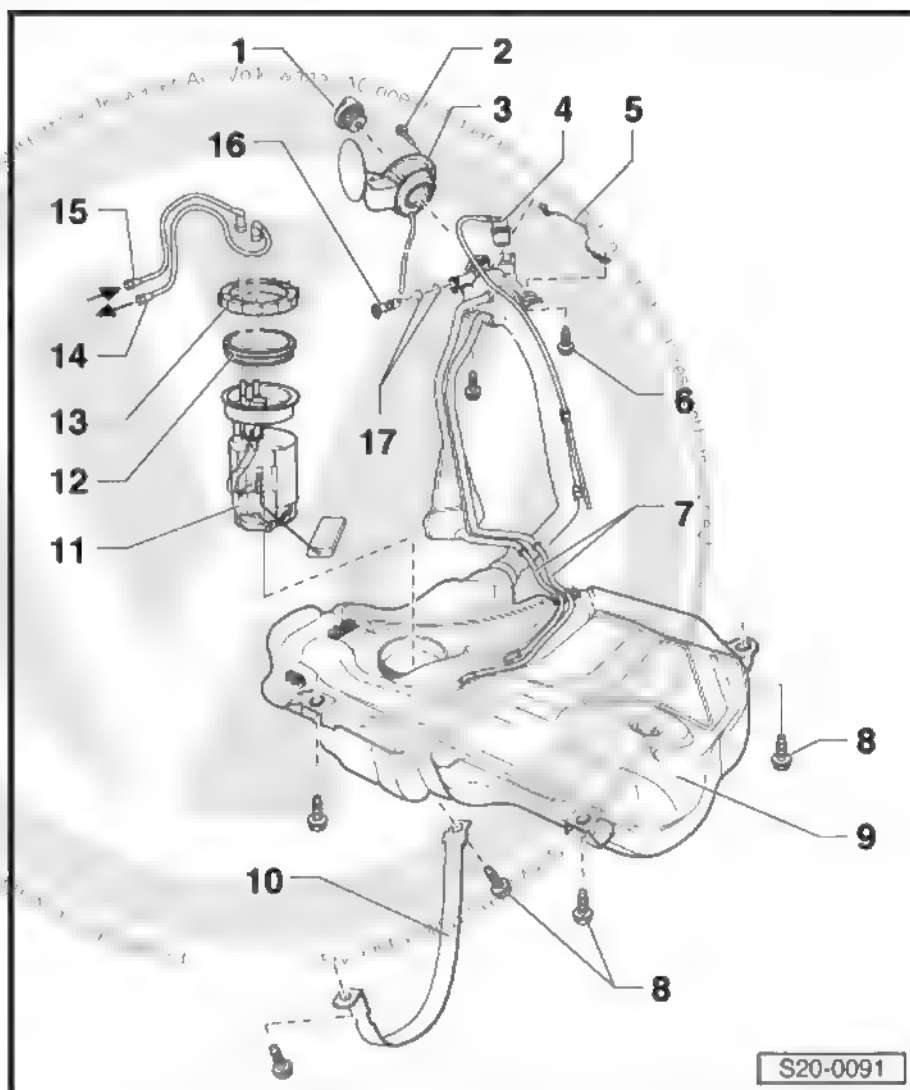
- ☐ Remove and install with Wrench -3217-

14 - Piping

- ☐ For the fuel filter ⇒ [Item 6 \(page 80\)](#)
- ☐ Fixed on the fuel tank
- ☐ Black
- ☐ In order to disconnect from the flange, press the connector lock keys

15 - Return hose

- ☐ From the fuel filter ⇒ [Item 6 \(page 80\)](#)
- ☐ Blue or marked with blue color
- ☐ Fixed on the fuel tank
- ☐ Ensure proper fixing
- ☐ In order to disconnect from the flange, press the connection locks





#### 16 - Ventilation valve

- ☐ Check → [page 79](#)
- ☐ In order to remove the valve, move it sideways of the clamp nozzles
- ☐ Prior to installation, unscrew nozzle cover

#### 17 - Seal ring

- ☐ Replace when damaged

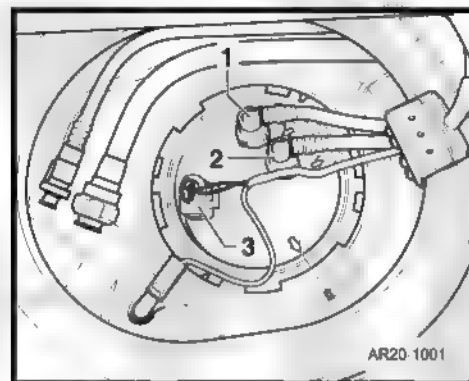
#### Installation position of the fuel pump

The arrow on the sensor should match with the mark on body right side -arrow-.

Blue return hose -1- or with blue mark at the connection -R-.

Supply hose -2- or with black mark at the connection -V-.

Electric pump connector -3-.



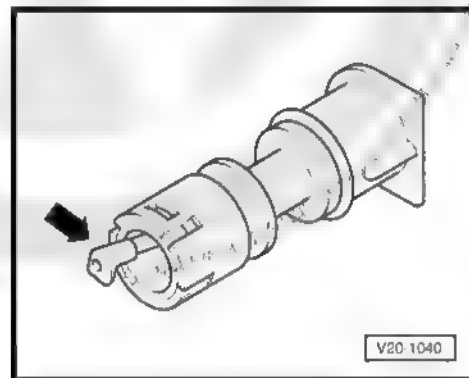
#### Note

*After installing the fuel pump, check if the input, return and ventilation hoses are still fixed on the fuel tank.*

#### Check the ventilation valve

Lever in resting position: closed.

Lever pushed in direction of arrow -arrow-: open.



#### Note

*Prior to installing the ventilation valve, remove the nozzle cover.*



## 1.2 Fuel filter - repair

### 1 - Return hose

- ☐ From injection pump
- ☐ Blue or marked with blue color
- ☐ Ensure proper fixing

### 2 - Piping

- ☐ To the injection pump
- ☐ White or marked with white color
- ☐ Ensure proper fixing

### 3 - Clip

- ☐ Ensure proper fixing

### 4 - Regulation valve

- ☐ Installation position: the arrow shall face the fuel tank
- ☐ When changing the filter, remove the clamp and regulation valve with the connected fuel hoses
- ☐ Below + 15 °C: Passage to the filter is open
- ☐ Above + 31 °C: Passage to the filter is closed

### 5 - Return hose

- ☐ To the fuel filter
- ☐ Blue or marked with blue color

### 6 - Piping

- ☐ From the tank
- ☐ White or marked with white color

### 7 - Fuel filter

- ☐ Remove and install ⇒ [page 81](#)
- ☐ Prior to installation, supply it with fuel
- ☐ The flow direction is indicated by arrows
- ☐ Do not change connectors
- ☐ Replace when damaged

### 8 - Gasket

- ☐ Replace when damaged

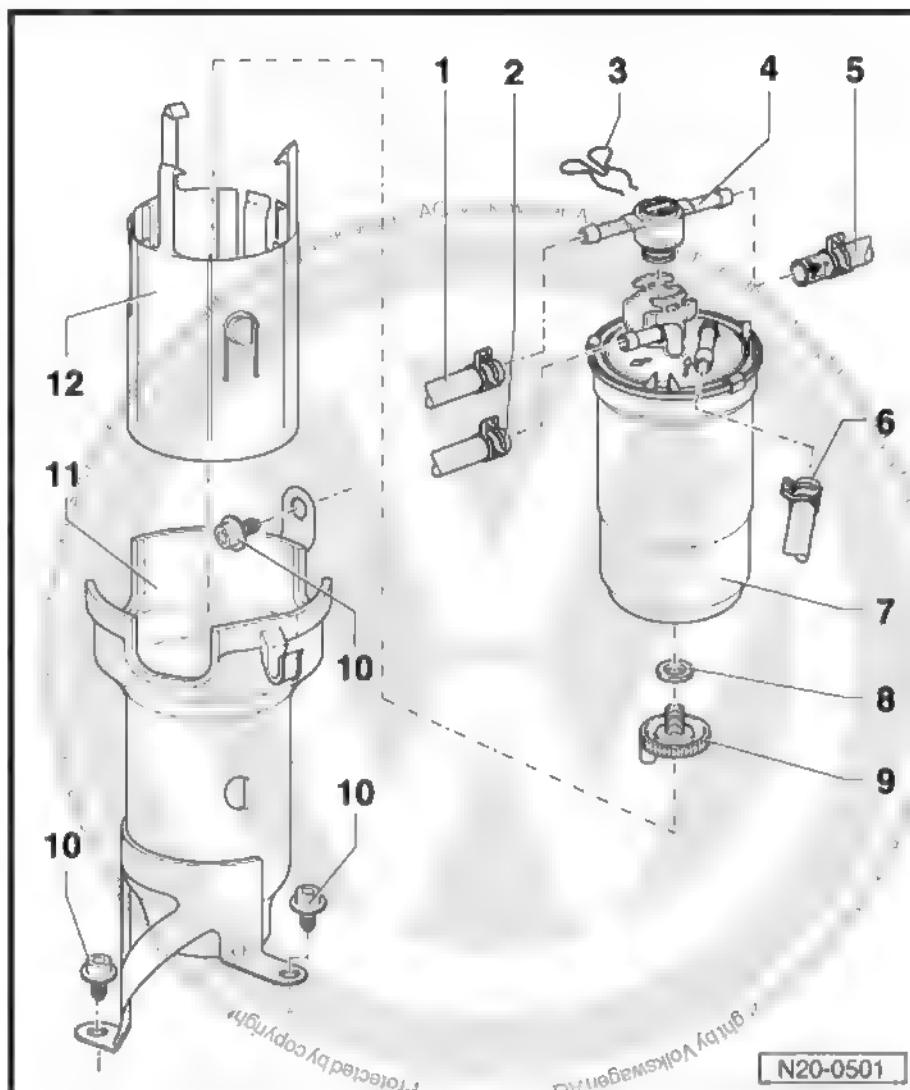
### 9 - Drainage screw

- ☐ For ventilation, loosen the clip and remove the regulation valve with the connected fuel hoses
- ☐ Drain approx. 100 cm<sup>3</sup> of liquid

10 - 25 Nm

11 - Support for fuel filter

12 - Fitting





## Removal and installation of the fuel filter

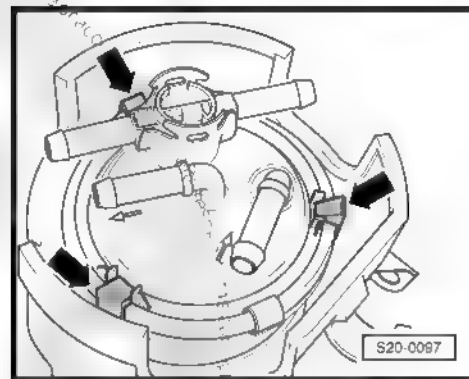
Disconnect the fuel hoses from the fuel filter

Bend the locks -arrows- outwards and remove the fuel filter



### Note

The fuel filter can be placed in one position only



## 1.3 Safety measures for work on the fuel supply



### WARNING

During assembly work, especially on the engine compartment, take the following into account due to lack of space:

- ◆ All hoses (e.g. fuel, hydraulic, activated charcoal filter system, coolant and refrigerant gas, brake fluid, vacuum) and electric cables must be arranged in a way to return to their original positions.
- ◆ Ensure easy access to all mobile parts or that may be hot.



### WARNING

- ◆ Fuel as well as fuel piping may get very hot (danger of burns)!
- ◆ Besides that, the fuel system is also under pressure! Prior to loosening the hose junctions, place a cloth around them. Then eliminate the pressure by carefully removing the hose.
- ◆ For all installation work on the fuel system, wear safety goggles and protection gloves!

- ◆ Before starting jobs it is necessary to have, near the installation area of fuel container, the sucking hose of an extracting equipment (exhauster) in operation, to absorb gases released by the fuel. If there is no extraction equipment (exhauster) available, use a radial blower (the engine must be away from the air flow) with an air volume above 15 m<sup>3</sup>/ hour.
- ◆ Avoid contact of fuel with the skin! Use fuel protection gloves!

## 1.4 Rules for cleanliness

For jobs on the fuel and injection system, strictly observe the following "6 cleaning" rules

- ◆ Thoroughly clean the connections and surrounding areas before disconnecting them
- ◆ Place the removed parts on a clean surface and cover them. Do not use cloths with lints!
- ◆ If repair work is not immediately carried out, open components shall be covered and carefully reserved.

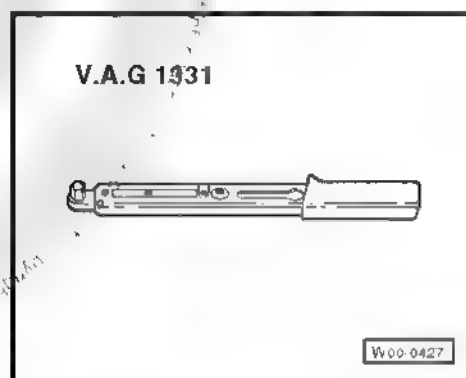


- ◆ Only install clean components. Remove the spare parts from their packaging just before installing them. Do not install components that have been kept out of packaging (i.e. inside the tool box, etc.)
- ◆ With open system: If possible, avoid the use of compressed air. If possible, do not move the vehicle
- ◆ Ensure there is no contact between diesel and cooling hoses. In case it happens, the hoses shall be immediately cleaned. Replace damaged hoses.

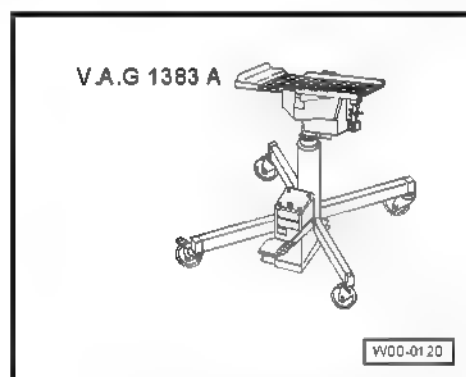
## 1.5 Fuel tank - remove and install

Special tools and workshop equipment required

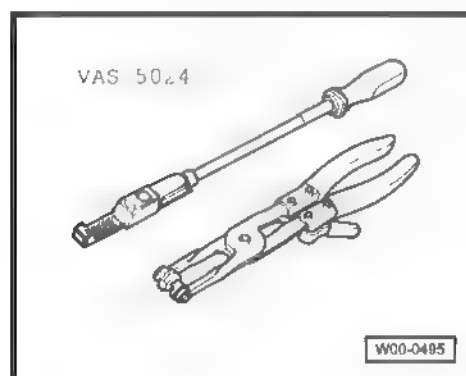
- ◆ Torque wrench - 5 to 50Nm (socket 1/2") -VAG 1331-



- ◆ Engine-/gearbox jack -VAG 1383A-



- ◆ Standard-type clamp pliers -VW 5162 (VWB) - or - VAS 5024A-



### 1.5.1 Removal

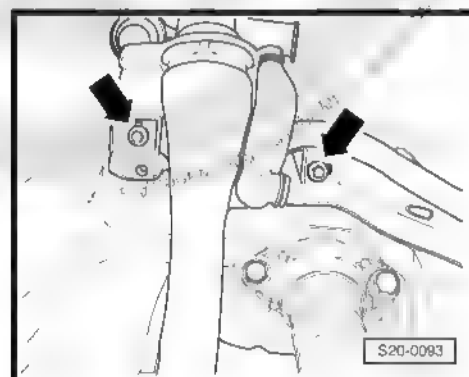
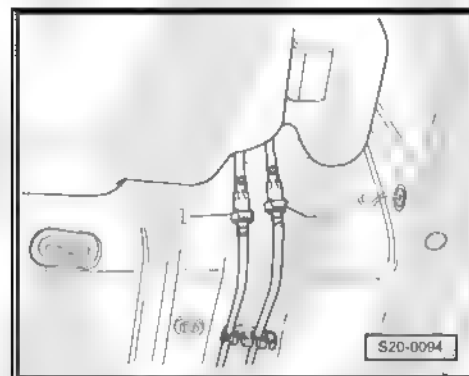
Prerequisites:

- The fuel tank shall only be filled up to half level



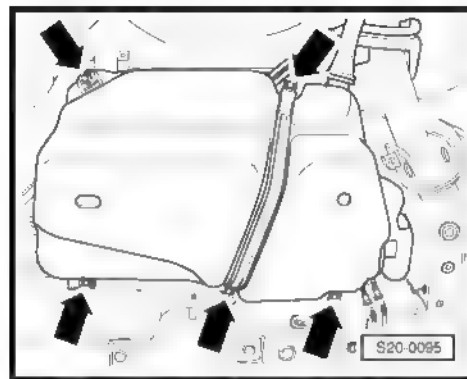
**i** Note

- ◆ *Drain fuel tank with Fuel suction and storage device -VAS 5190-.*
  - ◆ *Before you begin removal jobs, take safety precautions*  
*→ [page 81](#).*
  - ◆ *Check whether the vehicle has a coded radio. If so, request the anti-theft code before disconnecting the battery earth strap*
- With the ignition switched off, disconnect the battery ground cable of Battery -A-.
  - Fold the rear seat frontwards.
  - Remove the access cover of the fuel pump.
  - Disconnect the 2-pole connector from the pump flange.
  - Remove the supply and return hoses from the pump flange.
  - Release the exhaust system. The exhaust system shall be wired on the body and lowered a bit.
  - Remove the heat deflector between the exhaust and the fuel tank.
  - Release supply hose -1- and return hose -2- at the fuel tank, front right hand side.
- 
- Remove the attaching screws -arrows- at the filler neck.





- Remove the attaching screws -arrows-, support the fuel tank with Engine-/gearbox jack -EQ 7081 (VWB) - or - VAG 1383A- .
- Remove the fill nozzle of the rubber reservoir.
- Lower the fuel tank.



## 1.5.2 Installation

Installation is carried out in the reverse order of removal, considering the following:

- ◆ Install the ventilation and fuel hoses without bending them.
- ◆ Check the correct seating of the fuel hoses.
- ◆ Do not invert the supply and return lines (the return hose is blue or with marked with blue color, the supply hose is black).



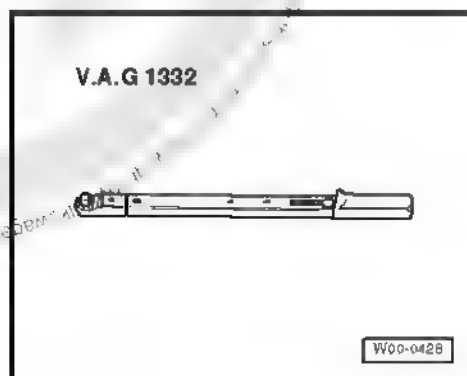
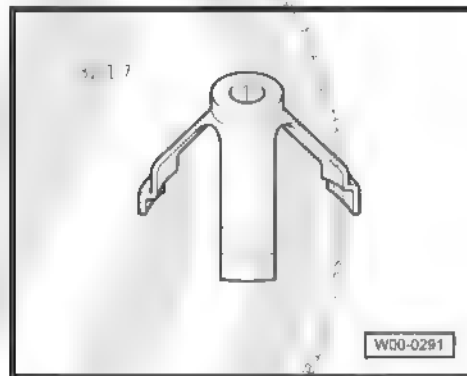
### Note

*Once the fuel tank is installed, check if the supply, return and ventilation hoses are still fixed.*

## 1.6 Pre-fuel supply pump - remove and install

Special tools and workshop equipment required

- ◆ Wrench -3217-
- ◆ Torquemeter - 40 to 200 Nm (socket 1/2") -VAG 1332-





### 1.6.1 Removal

- Follow the safety measures → [page 81](#) .
- Respect cleaning rules → [page 81](#) .



#### Note

*Check whether the vehicle has a coded radio. If so, request the anti-theft code before disconnecting the battery earth strap.*

- With the ignition turned off, disconnect the ground cable from the battery.
- Fold the rear seat frontwards.
- Remove the access cover to the fuel pump.
- Disconnect the 2-pole connector from the flange.
- Remove the supply and return hoses from the pump flange.



#### WARNING

- ◆ *Fuel as well as fuel piping may get very hot (danger of burns)!*
- ◆ *Besides that, the fuel system is also under pressure! Prior to loosening the hose junctions, place a cloth around them. Then eliminate the pressure by carefully removing the hose.*
- ◆ *For all installation work on the fuel system, wear safety goggles and protection gloves!*



#### Note

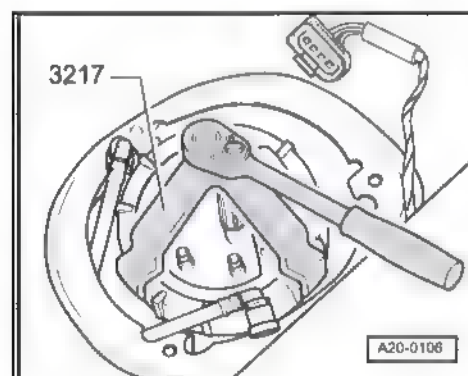
*In order to disconnect from the flange hoses, press the connection locks.*

- Remove the fuel pump fixing nut with the Wrench -3217-
- Remove the fuel pump from the fuel tank opening.



#### Note

*In case the fuel pump is replaced, empty the old pump before disposing it.*



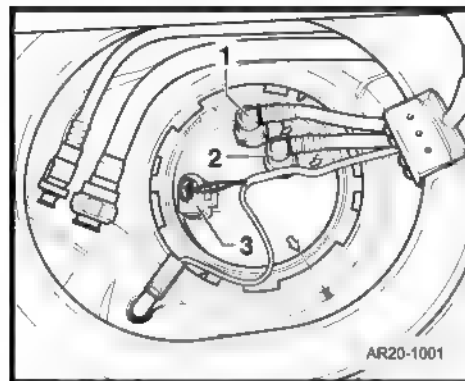
### 1.6.2 Installation

Installation is carried out in the reverse order of removal, considering the following:



#### Note

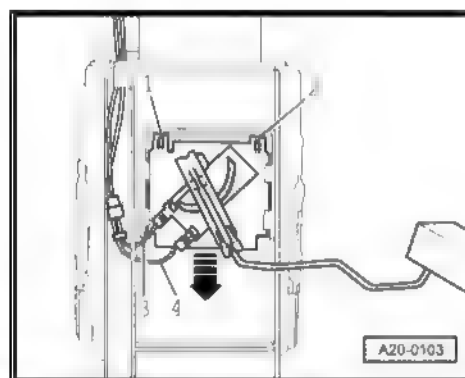
- ◆ Avoid bending the fuel level sensor while installing it.
- ◆ Place the dry fuel pump seal on the opening of the fuel tank.
- ◆ Lubricate the seal with fuel for the installation of the fuel pump only.
- ◆ Check the correct seating of the fuel hoses.
- ◆ After installing the fuel pump flange, check if the supply, return and ventilation hoses are still fixed on the fuel tank.
- ◆ Observe the installation position of the fuel pump flange: Flange marking must coincide with body marking -arrows-.



## 1.7 Fuel level measurer - remove and install

### 1.7.1 Removal

- Remove fuel presupply pump ⇒ [page 84](#) .
- Disconnect terminals -3- and -4- of the sensor.
- Lift the fastening clips -1- and -2- move the fuel level sensor with a screwdriver in the direction of the -arrow-.



### 1.7.2 Installation

- Place the fuel level sensor on fuel pump guides and press it upwards until it fits.
- Install fuel delivery unit ⇒ [page 84](#) .

## 1.8 Throttle control system - repair



1 - Pedal support

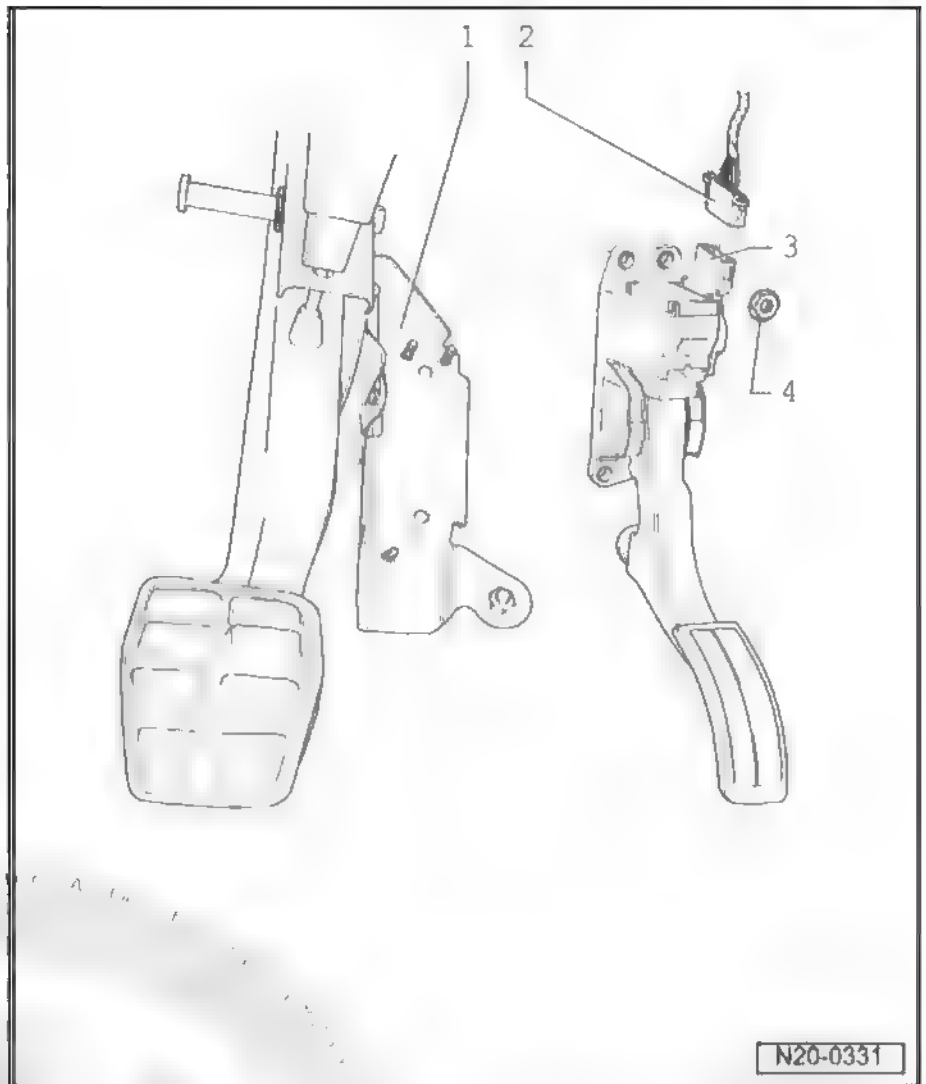
2 - Connector

□ Black

□ 6 poles

3 - Accelerator position sender  
-G79-

4 - 10 Nm





## 23 – Supply system - fuel injection (diesel)

### 1 Diesel direct injection system - repair



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

A Diesel direct injection system control unit -J248- is equipped with self-diagnosis. Prior to performing repairs and localizing faults, consult the fault memory ➔ [page 99](#) .

Safety measures ➔ [page 88](#) .

Rules for cleanliness ➔ [page 81](#) .

#### 1.1 Safety measures



#### WARNING

*During assembly work, especially on the engine compartment, take the following into account due to lack of space:*

- ◆ *All hoses (e.g. fuel, hydraulic, activated charcoal filter system, coolant and refrigerant gas, brake fluid, vacuum) and electric cables must be arranged in a way to return to their original positions.*
- ◆ *Ensure easy access to all mobile parts or that may be hot.*

In order to avoid personal injuries and/or damages to the injection and pre-heating equipment, observe the following:

- ◆ Disconnect and connect cables and wires of the injection and pre-heating system, as well as the cables of measurement equipment while the ignition is turned off.
- ◆ Should you wish to rotate the engine at starting rotation without operating, e.g. at a compression test, disconnect the 10-pole connector from the injection pump.
- ◆ Check whether the vehicle has a coded radio. If so, request the anti-theft code before disconnecting the battery earth strap.
- ◆ Connect and disconnect the battery only when the ignition is turned off, otherwise the diesel direct injection system control unit may be damaged.

If test and measurement equipment are used during a test drive, observe the following:

- ◆ Always install test and measurement equipment on the rear seat so that a second mechanic is able to use them too.

If test and measurement equipment are operated on the front passenger seat, a person may be seriously injured if the airbag is triggered in case of an accident.

#### 1.2 Injection pump - repair

- ◆ Respect cleaning rules ➔ [page 81](#) .
- ◆ Remove and install the injection pump ➔ [page 92](#) .



- ◆ Check and test the start of the injection dynamically  
→ [page 101](#) .
- ◆ Always replace the seal rings

1 - 25 Nm

2 - Injection pump gear

3 - Fastening nut

- ☐ To hub
- ☐ Under no circumstances shall it be released! Otherwise, the basic injection pump adjustment is endangered and can not be adjusted with the regular facilities of a workshop.

4 - Connection flange

- ☐ 25 Nm
- ☐ To supply tube

5 - Sealing ring

- ☐ Replace

6 - Fuel shut-off valve -N109-

- ☐ 40 Nm

7 - Connection nozzle

- ☐ To return hose

8 - Return hose

- ☐ To regulation/fuel filter valve

9 - 25 Nm

10 - Injection piping

- ☐ 25 Nm
- ☐ Always remove the whole tube set
- ☐ Do not change bending
- ☐ Remove with the Ring spanner -3035 -

11 - Connection flange

- ☐ 45 Nm
- ☐ With pressure valve

12 - 25 Nm

13 - Injector

- ☐ To cylinder 3 with needle stroke sensor
- ☐ Remove and install ⇒ [page 96](#)
- ☐ Check ⇒ [page 97](#)

14 - 20 Nm

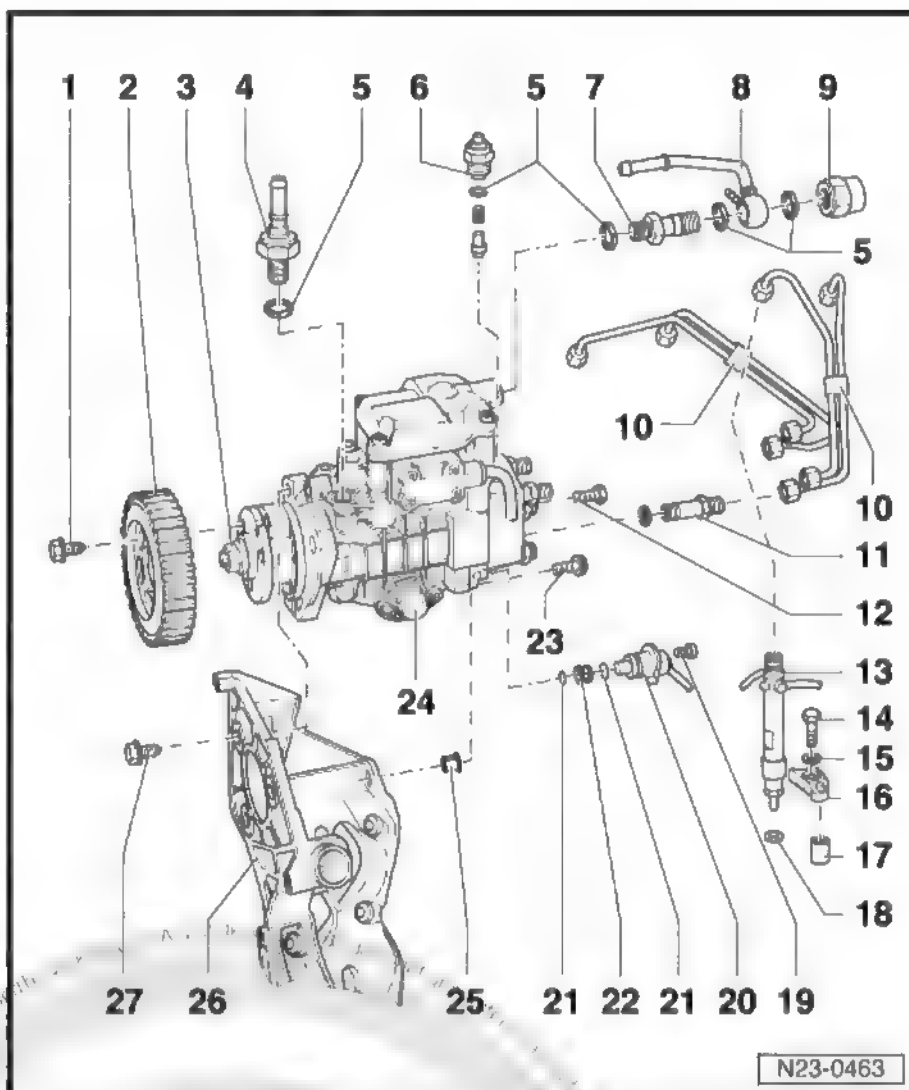
15 - Spherical hub cap

16 - Tension loop

17 - Support

18 - Heat protection seal

- ☐ Replace





19 - 10 Nm

20 - Commencement of injection valve -N108-

21 - Seal ring

- ☐ Replace

22 - Screen filter

23 - 30 Nm

24 - Voltage regulator box cover

- ☐ In case of leakage, replace the seal ring → [page 90](#)

25 - Sleeve

- ☐ With nut

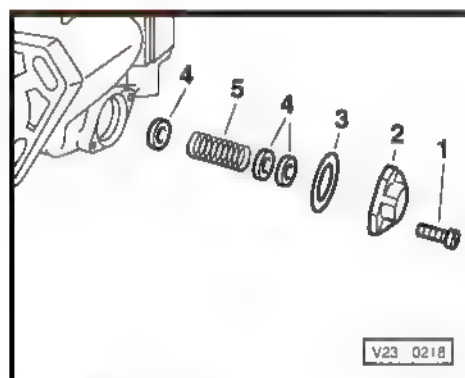
26 - Compact support

- ☐ Remove and install → [page 11](#)

27 - 30 Nm

#### Replacement of the seal ring of the injection regulation cover

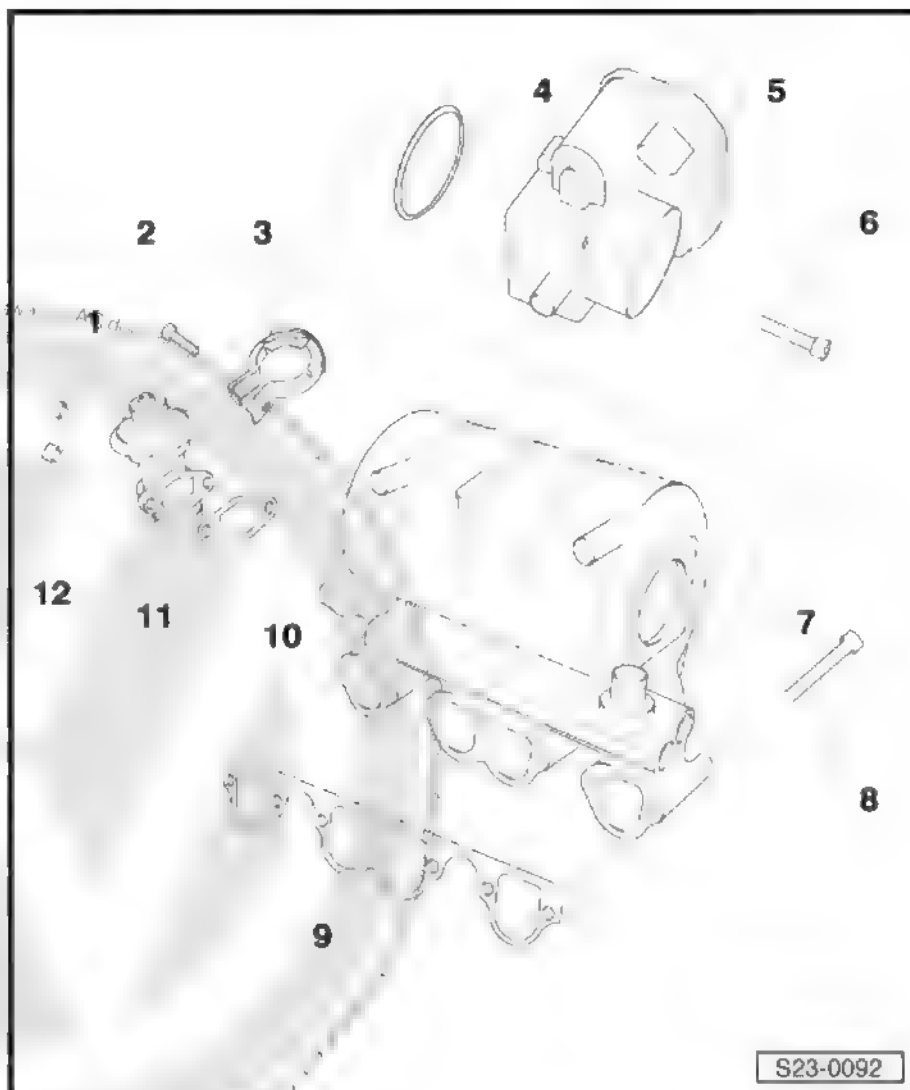
- Place a clean cloth under the injection pump.
- Loosen cover screws -1-.
- Remove the cover -2- and clean it.
- Replace the sealing ring -3- and install cover with existing compensation discs -4-.





### 1.3 Intake manifold - remove and install

- 1 - 25 Nm
- 2 - 10 Nm
- 3 - Tightening hose clamps
- 4 - Seal ring
  - ☐ Replace whenever removed
- 5 - Motor for intake manifold valve -V157-
- 6 - 10 Nm
- 7 - Oil sump ventilation connection
- 8 - 20 Nm
- 9 - Gasket
  - ☐ Replace whenever removed
- 10 - Suction tube
- 11 - Gasket
  - ☐ Replace whenever removed
- 12 - Exhaust gas recirculation valve -N18-

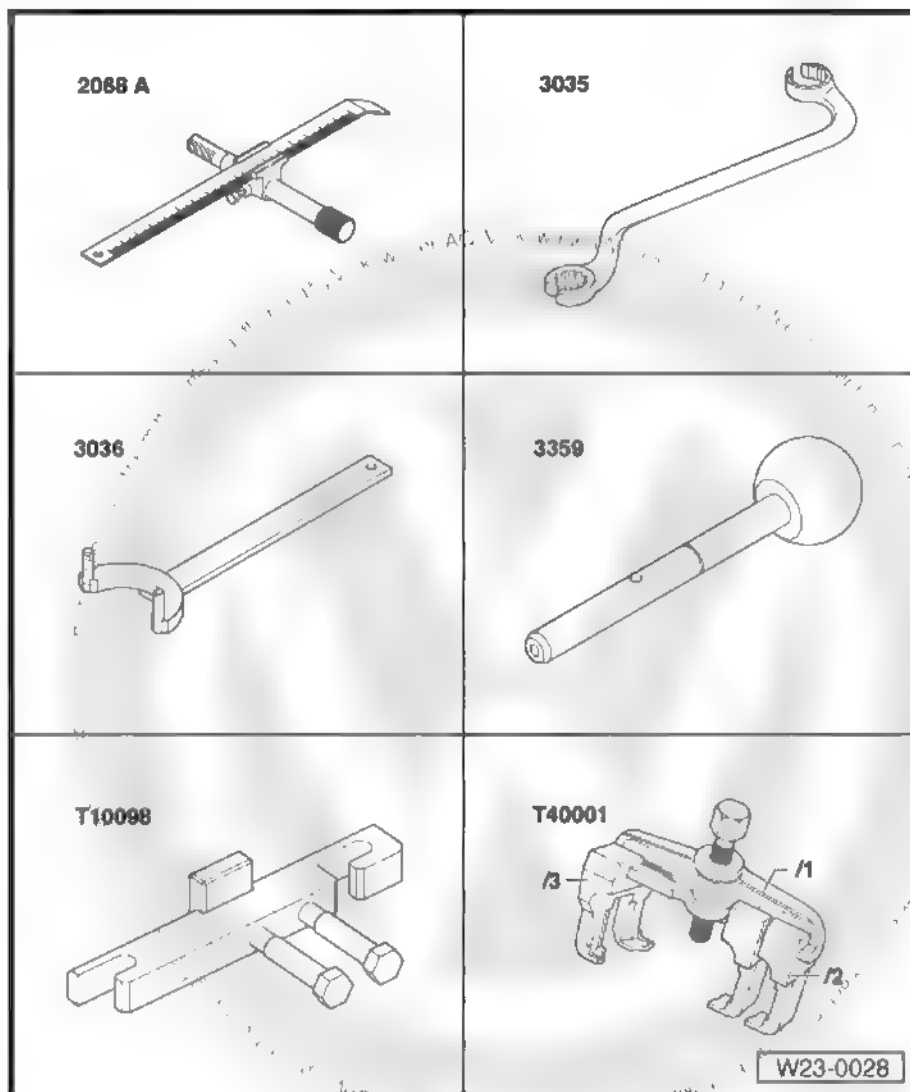




## 1.4 Injection pump - remove and install

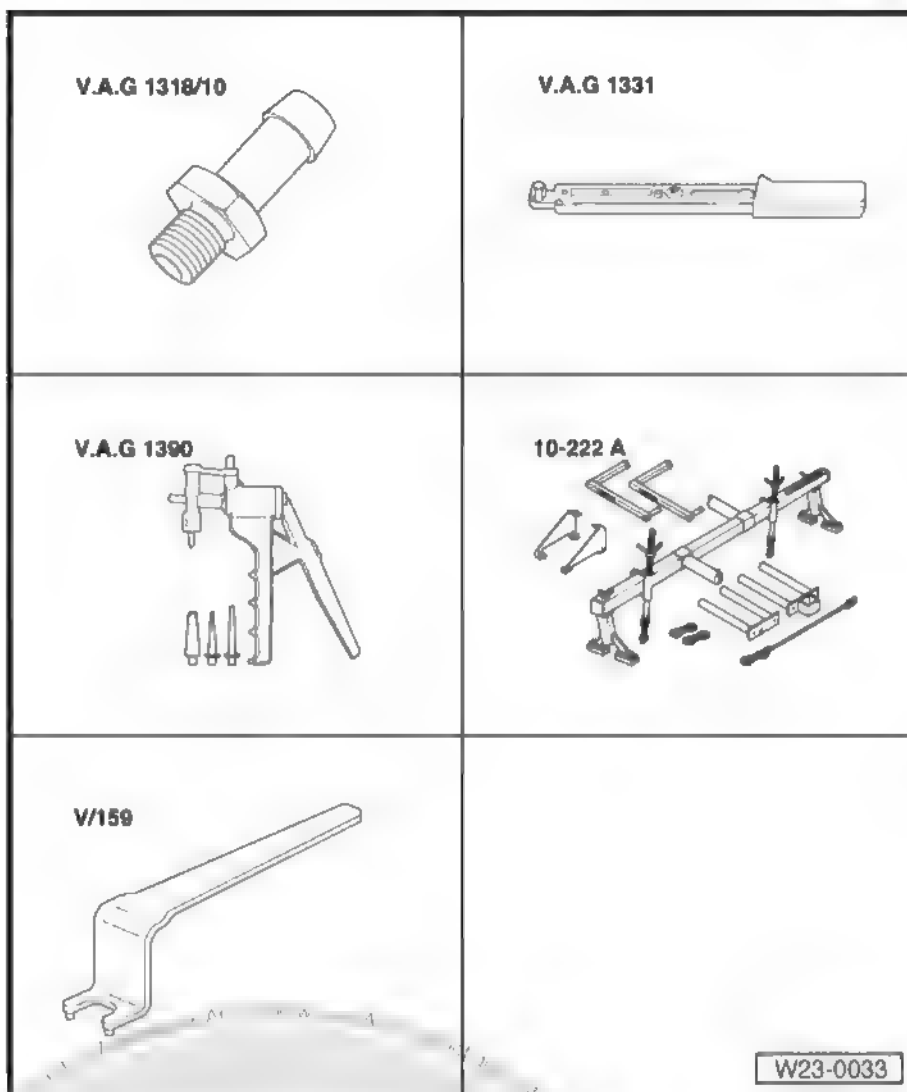
### Special tools and workshop equipment required

- ◆ Adjustment bar -2068 A-
- ◆ Ring spanner -3035 -
- ◆ Retainer -3036-
- ◆ Lock pin -3359-
- ◆ Camshaft bar -T10098 -
- ◆ Extractor -T 40001-
- ◆ Adapter -V.A.G 1318/10-





- ◆ Torque wrench - 5 to 50 Nm (socket 1/2") -VAG 1331-
- ◆ Vacuum pump -VAG 1390-
- ◆ Bracket or VW 061 -10-222A- with Bracket -10-222A/1-
- ◆ Wrench -V 159-



#### 1.4.1 Removal

- Loosen the toothed belt and remove it from the crankshaft gears and injection pump ⇒ [page 33](#) .



#### Note

*There is no need for removing the pulley and the lower protection of the toothed belt*

- Loosen all fuel piping from the pump.

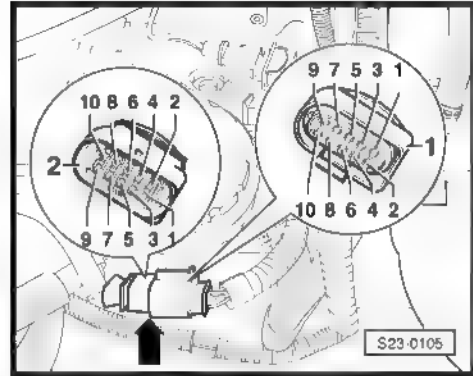


#### Note

- ◆ *In order to loosen the Injection piping, use the Ring spanner Ring spanner -3035- .*
- ◆ *Do not change the bending.*
- Cover the openings with a clean cloth.



- Disconnect the 10-pole connectors to the injection pump

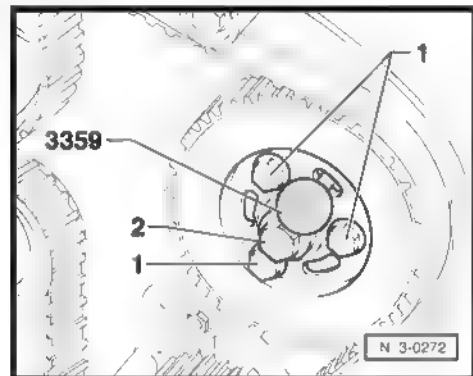


- Remove the fixing screws of the toothed belt gear -1-.

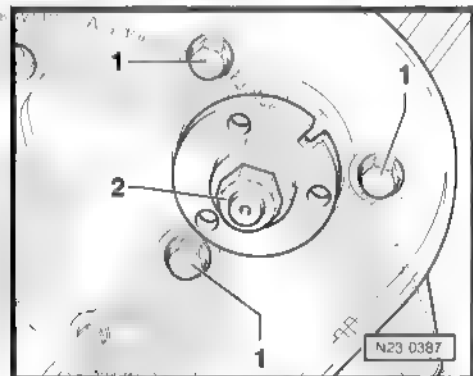


#### Note

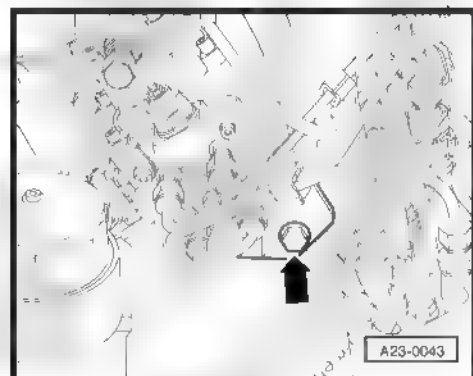
*The nut -2- under no circumstances shall the nut 2 to the hub be released. Otherwise, the basic injection pump adjustment is endangered and can not be adjusted with the regular facilities of a workshop.*



- Remove the attaching screws -1- of the compact support.



- Remove the fixing screws of the rear support arrow -arrow-.
- Remove the injection pump.

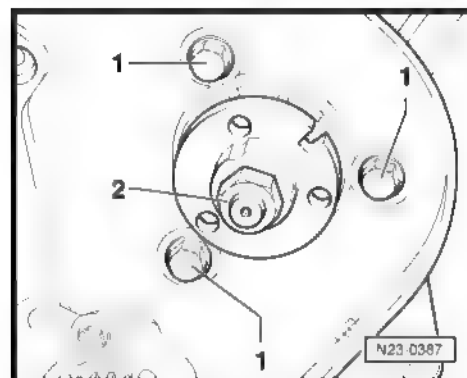


## 1.4.2 Installation

- Install the injection pump on the compact support and initially fix it to the rear support with a fixing nut.



- Install the fastening screws -1- and tighten with 30 Nm.

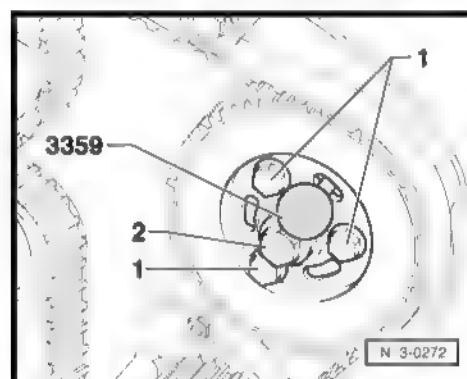


- Install the toothed belt gear with the fixing screws -1- on the hub.
- Lock the injection pump gear with the Lock pin -3359-.
- Align the injection pump gear on the oblong holes in central position.
- Loosen the gear fixing screw of the camshaft gear in one turn. In order to loosen the fixing screw, secure the camshaft gear with the Retainer -3036-.

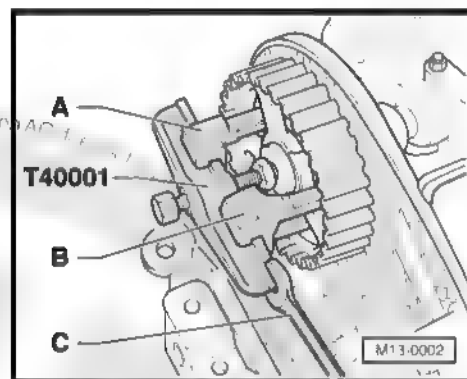


#### Note

*To loosen and tighten the camshaft gear use the Adjustment ruler -3418- or Camshaft bar -T10098- for counter support! Use the Retainer -3036- for this purpose.*

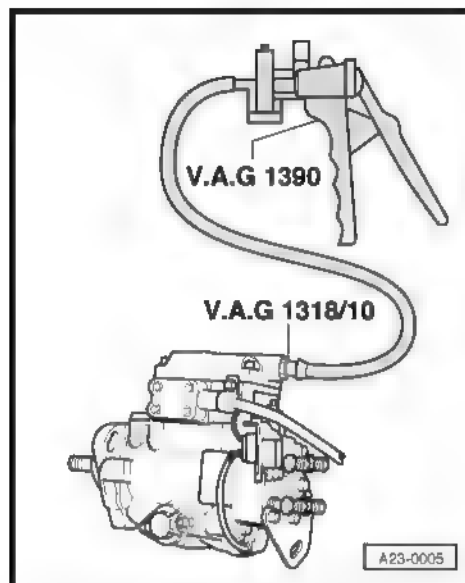


- Place the Extractor -T 40001- with The one-armed claw -T40001/2- -A- and the Two-armed claw -T40001/3- -B- centered on camshaft gear and extract. Use a wrench C as counter-support -C-.
- Remove the camshaft gear.
- Check if the mark of TDC on the flywheel aligns with the reference mark.
- Install the toothed belt on the injection pump gear and the tensioner pulley.
- Install the camshaft gear on the toothed belt and fix the gear to the camshaft, so that it still can be turned.
- Adjust the toothed belt ~~see~~ [page 33](#) .
- Install the injection piping and the electrical connections of the pump.





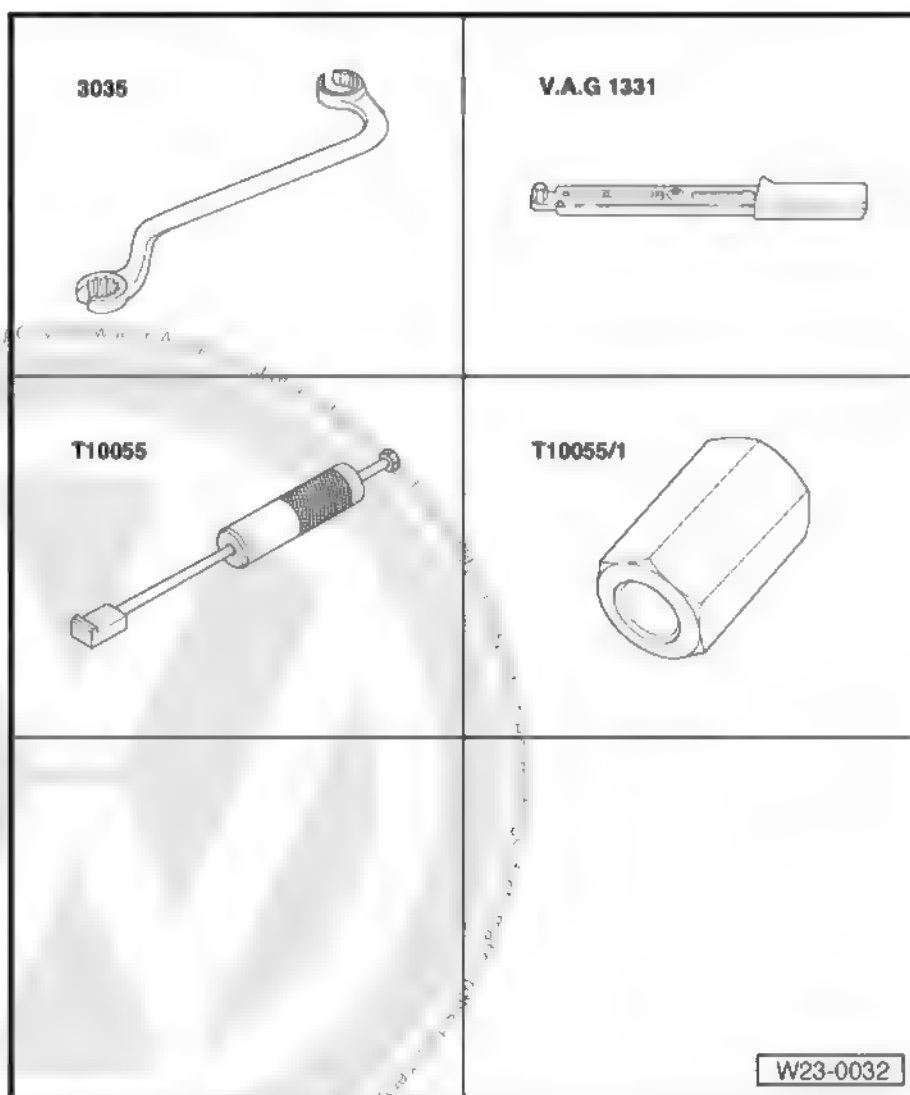
- Fill the injection pump with Diesel:
- Install the Adapter -V.A.G 1318/10- at the return opening of the injection pump.
- Connect the Vacuum pump -VAG 1390- with approx. 1 m of transparent plastic hose on the adapter.
- Drive the Vacuum pump -VAG 1390- , until fuel comes out of the return opening
- Remove the adapter and connect the fuel return hose.
- Check the injection starting and adjust it if necessary  
⇒ [page 101](#) .



## 1.5 Injectors - remove and install

Special tools and workshop equipment required

- ◆ Ring spanner -3035-
- ◆ Torque wrench - 5 to 50 Nm (socket 1/2") -VAG 1331-
- ◆ Extractor -T 10055-
- ◆ Adapter -T 10055/1-





## 1.5.1 Removal

- Remove the injection piping with the Ring spanner -3035-.



### Note

- ◆ Always remove the whole tube set.
- ◆ Do not change the bending shape

Loosen the fixing screw, remove the lock loop and remove the injector.

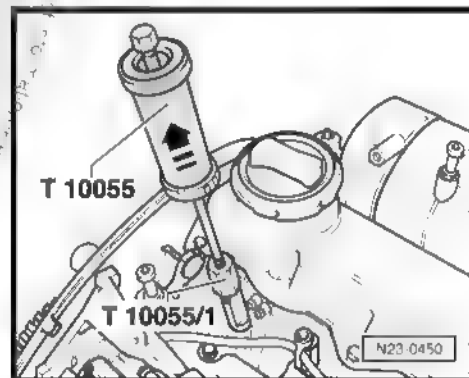


### Note

To remove stuck injector, use the Extractor -T 10055- with Adapter -T 10055/1-.

- Install the Extractor -T 10055- with Adapter -T 10055/1- on the injector.

Remove the injector by slightly hitting it upwards and removing it from cylinder head housing.



## 1.5.2 Installation



### Note

Always replace heat protection seals between the cylinder head and the injectors.

- Install the injectors with 25 Nm.
- Watch for correct seat of support bearings on the cylinder head.
- Install the lock loop with 20 Nm.

## 1.6 Injectors - check

The engine is equipped with 2 spring injectors. That is the reason why the fuel injection takes place in 2 steps. In case faults on the injectors are detected, replace them as neither pressure regulation nor repairs are possible.

Defective injectors cause the following problems

- ◆ Ignition faults
- ◆ Pin contact in one or more pistons
- ◆ Engine overheating
- ◆ Poor performance
- ◆ Excess of black smoke

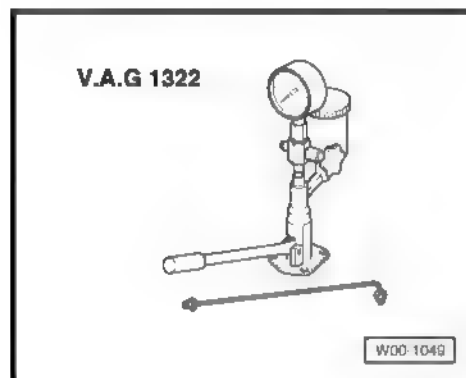


- ◆ High fuel consumption
- ◆ Excess of blue smoke on cold start

Faulty injectors can be identified by loosening the injection piping nuts in sequence, while the engine is running at idle. If after releasing a nut the engine speed remains constant, this indicates a faulty injector.

Special tools and workshop equipment required

- ◆ Injector test equipment -V.A.G 1322- with Pressure duct - V.A.G 1322/2-



Checking conditions:

- Connected pressure gauge

### 1.6.1 Check injection pressure

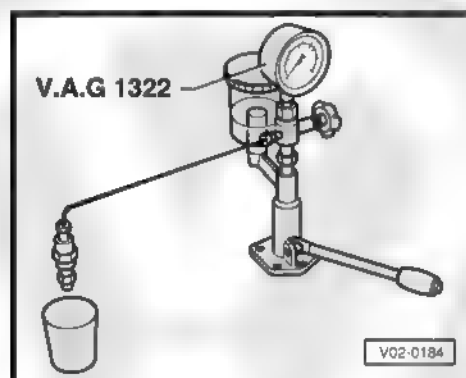


#### WARNING

*When testing injectors, watch that the fuel jet does not reach the hands, as high pressure fuel may penetrate the skin and cause serious injury.*

- Remove the injector ⇒ [page 96](#) .
- Connect the injector to the Injector test equipment -V.A.G 1322- .
- Slightly press the pump lever downwards. When injection starts, read the injection pressure. If pressure deviates from the nominal value, replace the injector.

Nominal values: (overpressure) New injectors: 220 ... 230 bar.  
Wear limit: 190 bar.



### 1.6.2 Check fuel proofness

- Slowly press the lever down and keep the pressure for 10 seconds at approx. 150 bar. There shall be any leakage through injector opening.
- In case there is leakage, replace the injector.



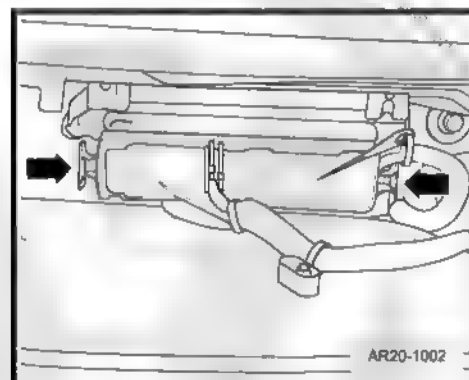
## 2 Diesel direct injection system control unit -J248-

### 2.1 Diesel direct injection system control unit -J248- - remove and install

- Before removing Diesel direct injection system control unit - J248- check the identification and coding of the old Diesel direct injection system control unit -J248- ⇒ Vehicle diagnosis, testing and information system VAS 5051.

#### 2.1.1 Removal

- Turn the ignition off.
- Remove the windshield wiper assembly ⇒ Electrical equipment; Rep. Gr. 92 ; Windshield wiper blade and arm set - remove and install .
- Remove the water deflector ⇒ Rep. Gr. 66 .
- Disconnect the connector from command unit fitting and remove it.
- Press the clips -arrows- outward and remove the control unit sideways.



#### 2.1.2 Installation

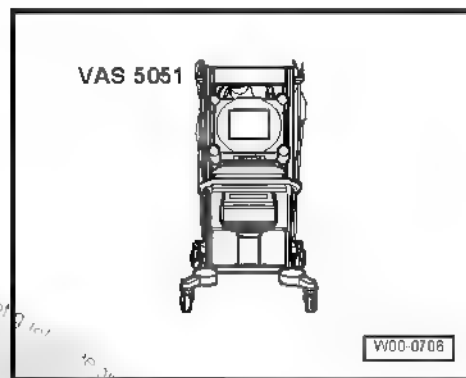
- Install the new command unit and press it to the left.
- Connect the connector and lock it.
- Check the fault memory of the new command unit and, if necessary, delete the fault memory ⇒ [page 99](#) .

### 2.2 Fault memory of the Diesel direct injection system control unit -J248- - check and erase

Special tools and workshop equipment required



- ◆ Diagnosis, Measurement and Information System -VAS 5051A/52-



- ◆ Diagnostic cable -VAS 5051/1- or Diagnostic cable -VAS 5051/3-
- Connect the Diagnosis, Measurement and Information System -VAS 5051A/52- ⇒ Electrical equipment; Rep. Gr. 97 ; Diagnosis, Measurement and Information System -VAS 5051A/52- - Connect .



#### WARNING

- ◆ *On test or measurement routes with the diagnosis, measurement and information system, there is possible risk of severe or fatal injuries.*
- ◆ *If the vehicle diagnosis and information system is placed in the airbag's radius of action during a test or measurement route and should the airbag be triggered in the case of accident, there is risk of severe or fatal injuries.*
- ◆ *Always install test and measurement equipment on the rear seat so that a second mechanic is able to use them too.*

- Run the engine at keep it at idle speed.

Only if the engine does not work:

- Turn the ignition on.

Select operation type:

- Press on the display Vehicle self-diagnosis.

Select the vehicle system:

- Press on the display 01 Electronic engine system.

The command unit identification and coding will be indicated on the display.

Selecting diagnosis function:

- Press on the display 02 Consult fault memory.
- In case there are no faults stored in the Diesel direct injection system control unit -J248- , the display will inform "0 faults detected"
- In case there are faults stored in the Diesel direct injection system control unit -J248- , they will be indicated in sequence on the display
- Press the ☐.
- Press on the display 05 Erase fault memory.

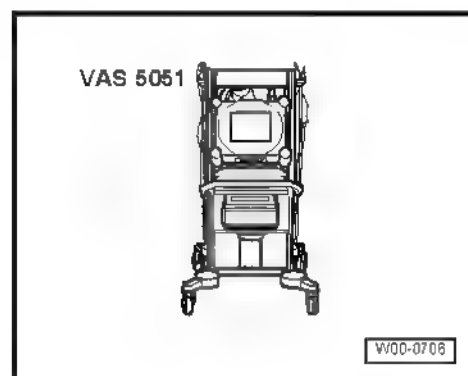


- Press the function key **06 Conclude test**.

## 2.3 Functions and components - adjust

Special tools and workshop equipment required

- ◆ Diagnosis, Measurement and Information System -VAS 5051A/52-



- ◆ Diagnostic cable -VAS 5051/1- or Diagnostic cable -VAS 5051/3-
- Connect the Diagnosis, Measurement and Information System -VAS 5051A/52- ⇒ Electrical equipment; Rep. Gr. 97 ; Diagnosis, Measurement and Information System -VAS 5051A/52- - Connect .

Select, on Diagnosis, Measurement and Information System -VAS 5051A/52- nd "Guided fault detection".

After consulting all command units:

- Press the **skip**.
- Select **Function/component selection**.
- Select **Operation**.
- Select **Engine identification codes**.
- Select **01 - Self-diagnosis systems**.
- Select **Engine control**.
- Select **Functions**.
- Select **Function or component**.



### Note

*Continue selecting the functions you want in Diagnosis, Measurement and Information System -VAS 5051A/52- ⇒ Vehicle diagnosis, testing and information system VAS 5051.*



## 26 – Exhaust system

### 1 Exhaust system components - remove and install



#### WARNING

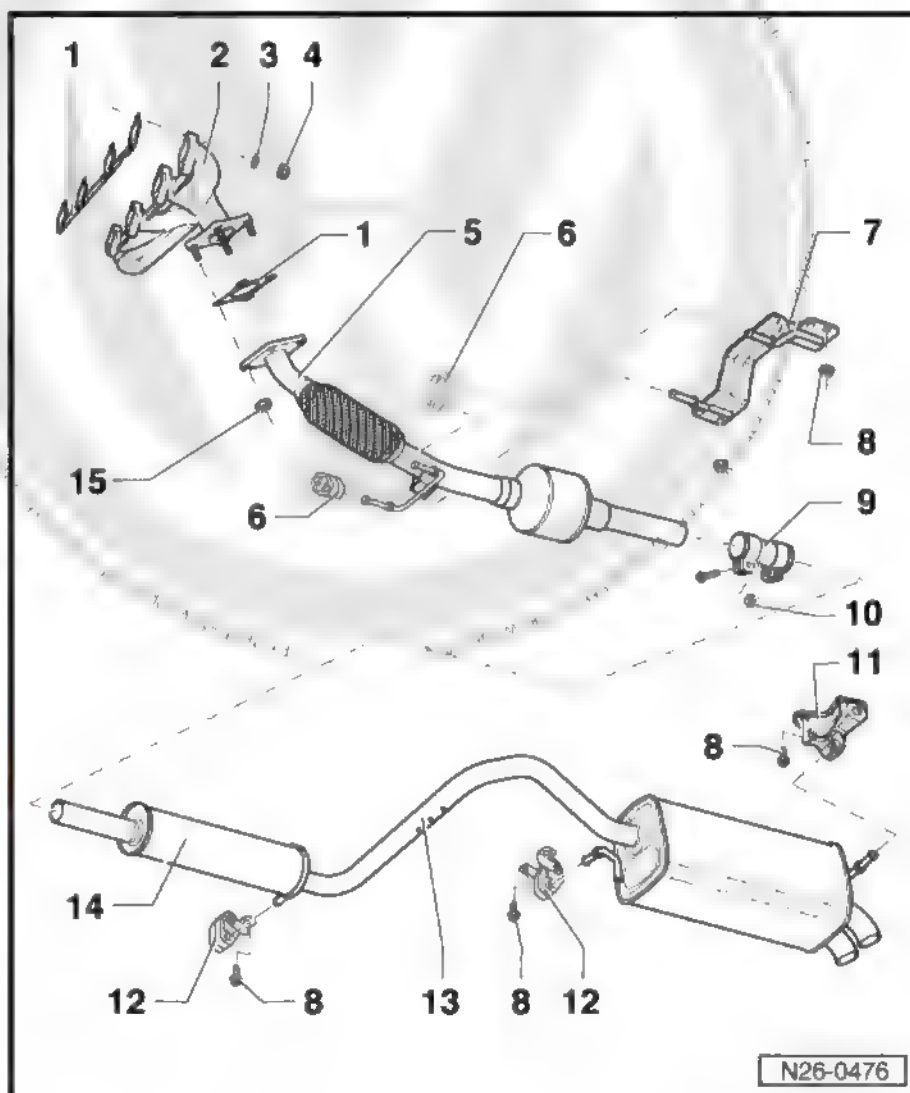
Always replace self-locking nuts and screws which were subjected to angular torque.



#### Note

After installing the exhaust system, ensure that the system is tension-free and and clearance to the body is sufficient. If necessary, loosen the double clamp (or clamps) and separate the muffler and the exhaust pipe so that they are sufficiently away from the body at their full length and that the brackets evenly support their weight.

- 1 - Gasket
  - ☐ Replace
- 2 - Exhaust manifold
  - ☐ With connection for exhaust gas recirculation
- 3 - Washer
- 4 - 25 Nm
  - ☐ Replace
- 5 - Front exhaust pipe with catalyzer unit
- 6 - Bearing support
- 7 - Support
- 8 - 23 Nm
- 9 - Double clamp
  - ☐ Installation position  
⇒ [page 103](#)
- 10 - 40 Nm
- 11 - Bearing support
  - ☐ Installation position  
⇒ [page 103](#)
- 12 - Bearing support
  - ☐ Installation position  
⇒ [page 103](#)
- 13 - Separation point
  - ☐ Identified through three prints on the exhaust pipe
  - ☐ The exhaust pipe and the rear muffler consti-





tute a single part as serial. They are supplied separately with a double clamp as spare parts for repair work.

- ❑ Cut the connection tube at the separation point with Pneumatic sabre saw -EQ 7415 (VWB) - or - VAG 1523A- at a 90° angle → [page 103](#)

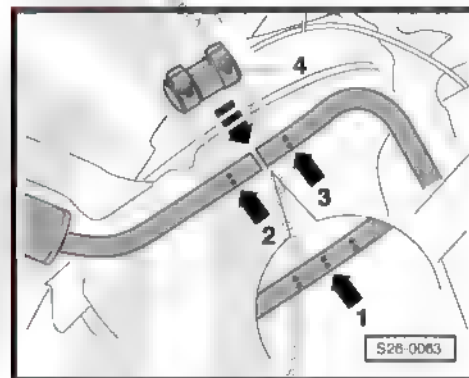
#### 14 - Remove the front pipe

- ❑ For repair purposes, replace it individually → [page 103](#)
- ❑ Installation position → [page 103](#)

#### 15 - 40 Nm

- ❑ Replace

#### Separation point on the exhaust pipe



#### Special tools and workshop equipment required

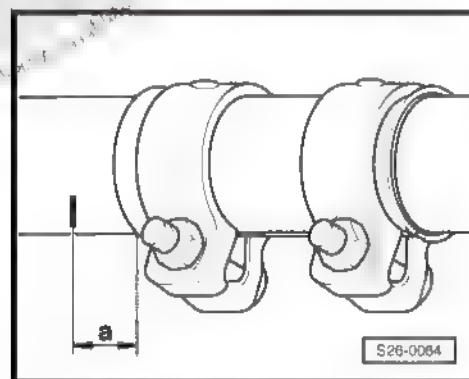
- ◆ Pneumatic sabre saw -EQ 7415 (VWB) - or - VAG 1523A-

#### Prerequisite:

- The exhaust system shall be cold.
- Cut the exhaust pipe in right angle and perpendicular to the cut point -arrow 1-.
- Position the double clamp -4- during installation, on the lateral identifications -arrows 2 and 3-. Tightening torque 40 Nm.

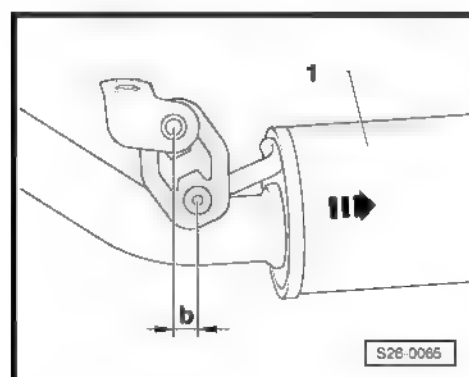
#### Assembly position of the double clamp:

- The distance -nd- The distance a between the double clamp and the mark shall be approx. 5 mm.



#### Installation position of the support bearing:

- Install silencer -1- must be placed to ensure dimension -b- is between 3...7 mm.





## 2 Exhaust gas recirculation system components - remove and install



### WARNING

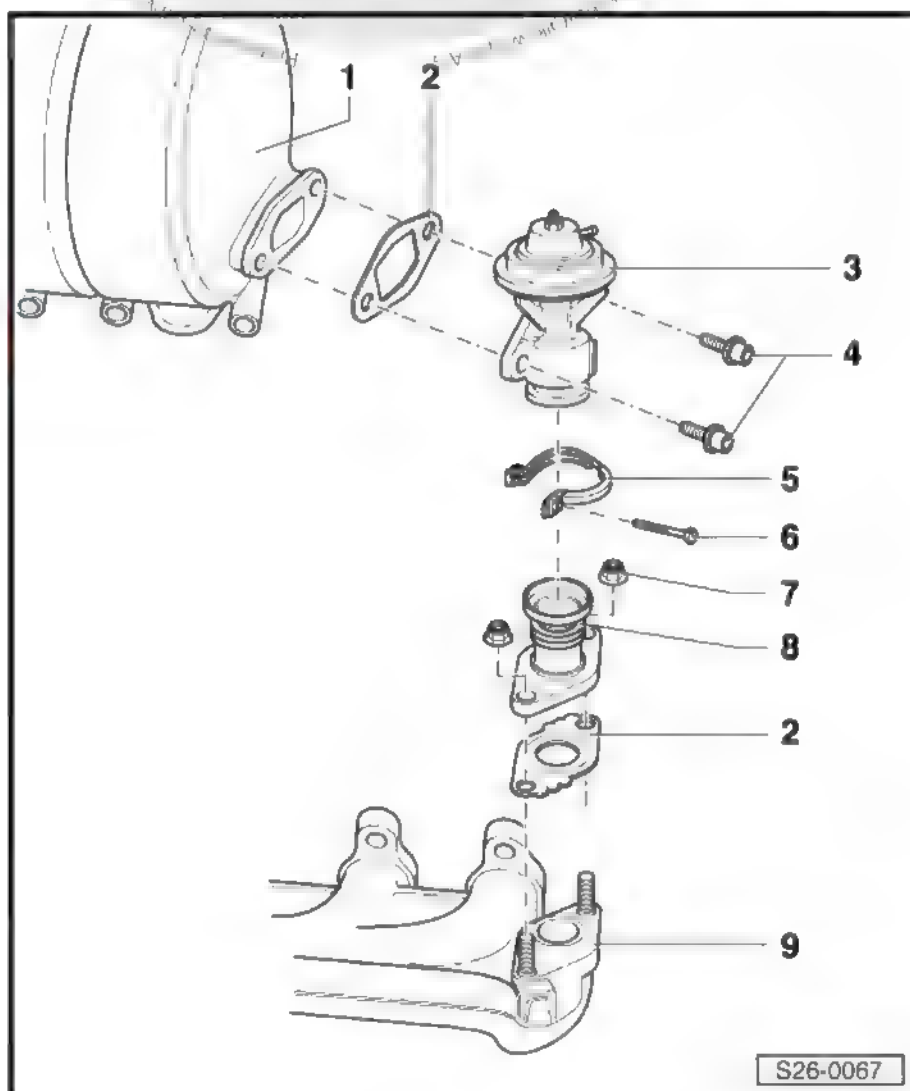
*Always replace self-locking nuts and screws which were subjected to angular torque.*



### Note

- ◆ Exhaust gas recirculation system control is performed by the Diesel direct injection system control unit -J248- through the Exhaust gas recirculation valve -N18-.
- ◆ The conical piston of the Exhaust gas recirculation valve -N18- allows a cross section variation according to different piston positions.
- ◆ Control by pulses makes all valve opening positions possible.

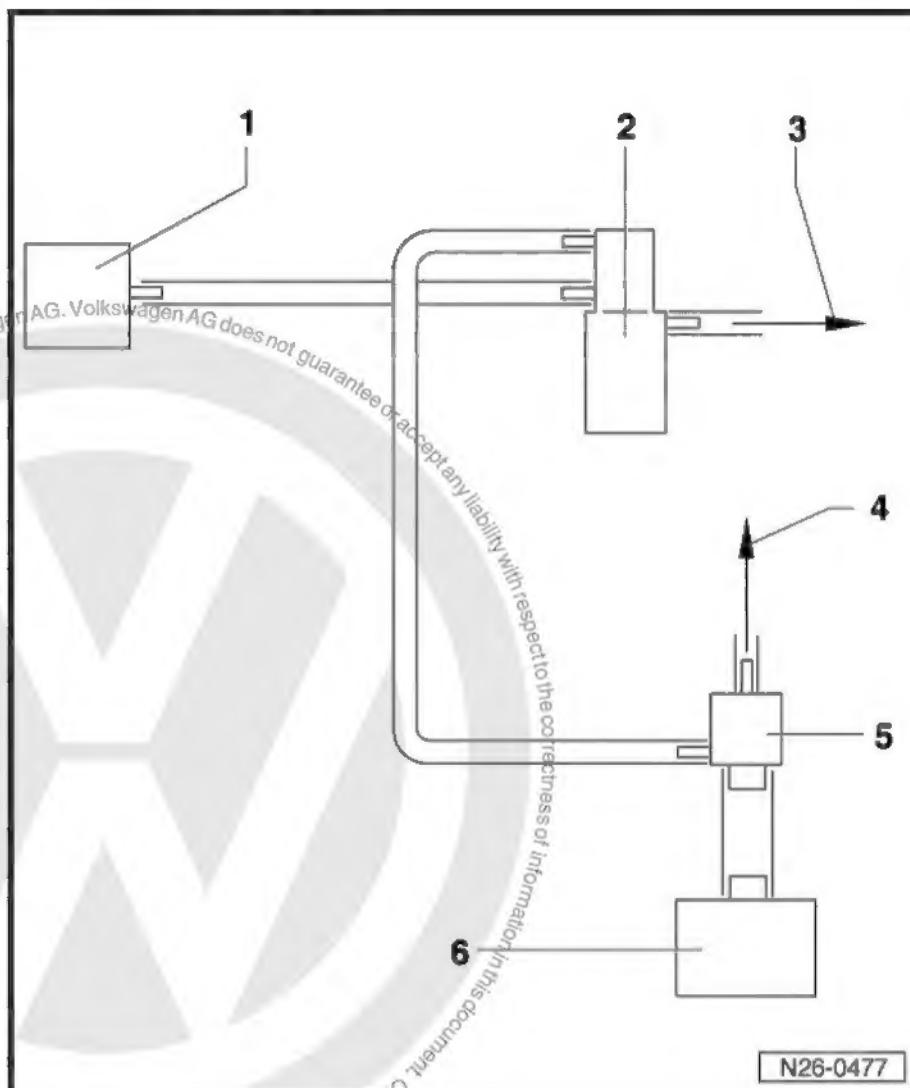
- 1 - Intake manifold
- 2 - Gasket
  - ☐ Always replace it after removal
- 3 - Exhaust gas recirculation valve -N18-
  - ☐ Check ⇒ [page 105](#)
- 4 - 25 Nm
- 5 - Tightening hose clamps
- 6 - 10 Nm
- 7 - 20 Nm
  - ☐ Always replace it after removal
- 8 - Connection tube
- 9 - Exhaust manifold





## 2.1 Vacuum hose connection diagram

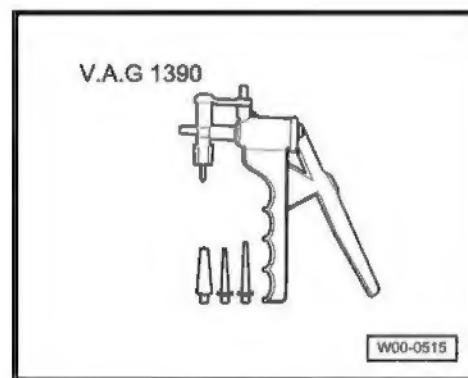
- 1 - Exhaust gas return valve
- 2 - Exhaust gas recirculation valve -N18-
- 3 - To the air cleaner
- 4 - To servo-brake
- 5 - Check valve
- ☐ Watch the installation position
- 6 - Vacuum pump



## 2.2 Exhaust gas recirculation valve -N18- - check

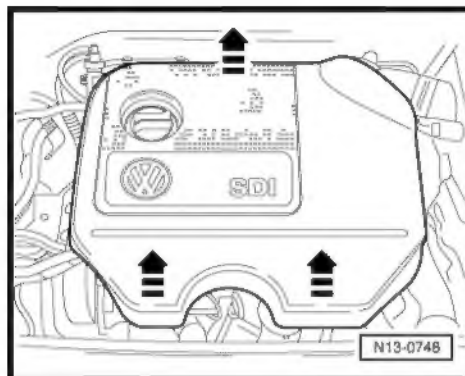
Special tools and workshop equipment required

- ◆ Vacuum pump -VAG 1390-

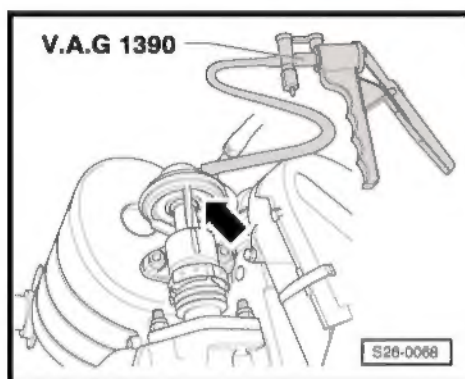




- Remove the engine cover in the direction of the arrows.
- Disconnect the vacuum tube from the Exhaust gas recirculation valve -N18- .



- Connect the Vacuum pump -VAG 1390- to the vacuum tube.
- Activate the pump. The membrane shall only move towards the vacuum connection. (Check direction on the bottom -arrow-).
- Disconnect the hose of the vacuum pump from the Exhaust gas recirculation valve -N18- . Closing of the valve shall be clearly audible. The membrane will move towards the exhaust manifold.





## 28 – Chamber pre-heating system

### 1 Chamber pre-heating system - check



#### WARNING

*Always replace self-locking nuts and screws which were subjected to angular torque.*

Special tools and workshop equipment required

- ◆ Portable multimeter -VAG 1526C-
- ◆ Measurement auxiliary cable set -VAG 1594C-

Checking conditions:

- Fuse number 176 on fuse holder/battery support is regular.
- The minimum battery voltage is 11.5 V.
- All electrical equipment, e.g. lights and rear window defogger shall be switched off.
- Diesel direct injection system control unit -J248- in order.
- Disconnect the 2-pole connector -1- of Coolant temperature sender -G62- -2-.



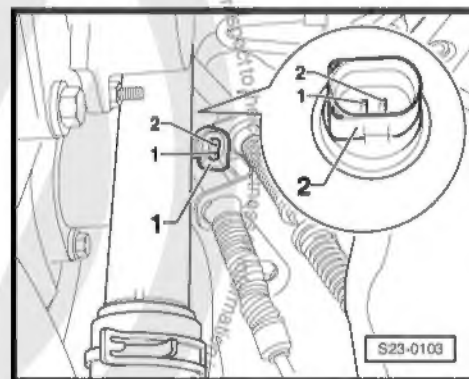
#### Note

*Disconnecting the connector from the Coolant temperature sender -G62- simulates the situation "of a very low engine temperature" and when the ignition is turned on, the corresponding pre-heating process is started.*

- Disconnect the connectors of the pre-heating spark plugs.
- Connect the multimeter in order to measure the tension between the spark plug connector and the vehicle's ground.
- Turn the ignition on for approx. 20 seconds. An approximate value to the battery voltage shall be indicated.

If there is no voltage:

- Refer to the fault memory, correct the faults and delete the fault memory ⇒ [page 99](#) .

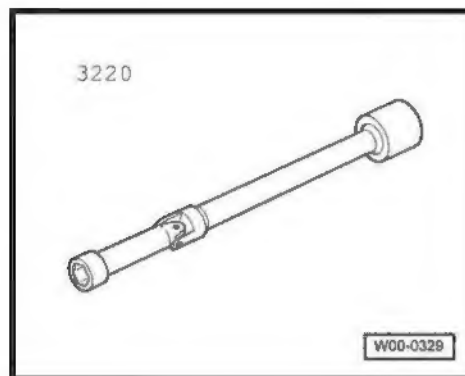


#### 1.1 Pre-heating spark plugs - check

Special tools and workshop equipment required



- ◆ Joint spanner 10 mm -3220-



- ◆ Measurement auxiliary cable set -VAG 1594C-
- ◆ Test tip -VAG 1527B-

Checking conditions:

- Fuse number 176 on fuse holder/battery support is regular.
- The minimum battery voltage is 11.5 V.
- All electrical equipment, e.g. lights and rear window defogger shall be switched off.
- Diesel direct injection system control unit -J248- in order.
- Disconnect the connectors of the pre-heating spark plugs.
- Connect the Test tip -VAG 1527B- with Measurement auxiliary cable set -VAG 1594C- to the positive pole (+) of the battery.
- Position Test tip -VAG 1527B- on each pre-heating plug, one after another. The diode turns on: Spark plug is regular. The diode does not turn on: replace the spark plug.

If the diode turns on, the pre-heating spark plug is regular. If does not turn on, the pre-heating spark plug is damaged and shall be replaced.

- Remove and install pre-heating plugs with the Joint spanner 10 mm -3220-. Tightening torque: 15 Nm.

05.2011

